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TROPICAL AGRICULTURE.

REPORT

ON THE

AGRICULTURAL DEPARTMENT, ST. VINCENT,

FOR THE YEAR

1935.

[Price Sixpence.]

Annual Report

of the

Agricultural Department.

St. Vincent.

1935.

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1937.

REVIEW BY THE COMMISSIONER OF AGRICULTURE OF THE REPORT.

In accordance with the usual procedure, the Report of the Agricultural Department of St. Vincent for 1935, prepared by the Agricultural Superintendent of St. Vincent, has been forwarded to the Commissioner of Agriculture at the Imperial College of Tropical Agriculture, Trinidad, Mr. G. A. Jones.

The following is an extract from his review of the Report :—

"2. Weather conditions were mainly normal throughout the year and agriculture in general consequently suffered no ill effect from adverse conditions. Rainfall was fairly well distributed throughout the year, the total being only slightly less than average.

3. The total export value of the products of agriculture and related industries amounted to £130,762 in 1935, being little more than the corresponding figure for 1934 but approximately 18 per cent more than in 1933. Comparison of the export value of the four main crops shows that whereas the export value of arrowroot and cotton products remained almost identical with the 1934 figures, the value of sugar products decreased and the value of coconut products increased.

4. The arrowroot crop of 1935 amounted to 7,287,000 lb., constituting a record production and representing an increase in production of about 10 per cent over that of the previous year. There was a slight increase in the total quantity of starch exported, but the continued increase in exports to the United States is worthy of special mention. Experimental work conducted by the Agricultural Department has proved conclusively that increased yields can be economically obtained by nitrogenous manuring. Attention, long overdue, is now being paid to factory methods and there is every probability that as a consequence factory efficiency will be considerably increased. The disturbing factor in the industry is the increased accumulation of stocks resulting from increased production. A campaign of advertising and of exploring other possible means of increasing consumption of arrowroot should now be vigorously undertaken.

5. Although the Sea Island cotton crop reaped in 1935 was well below average at 173,735 lb., the year saw a vigorous revival in the industry. An acreage of 3,540 acres was planted as compared with 1,464 acres in the previous year. The ready market for Sea Island cotton augurs well for the quick disposal of the crop at improved prices.

6. There is little change to be recorded in the sugar industry. The syrup producers however experienced much difficulty in disposing of their crop and a relatively large surplus was carried forward at the end of the year. In November 1935, on the recommendation of the College Advisory Department, a technical officer was appointed to investigate the causes of variation in quality of St. Vincent syrup and to introduce where possible improved methods in the process of manufacture with the object of standardising the quality.

7. There was a marked improvement in the position of the coconut industry in 1935. Exports of nuts increased from just under 1 million in 1934 to nearly 3½ million in 1935. There was a decline in the exports of copra, but the total value of coconut products increased by 50 per cent.

8. Among minor industries, special reference must be made to the new banana industry, which by the end of the year had expanded to an area of 530 acres.

9. The experimental work of the Department is carefully described in the report and will serve as a necessary and useful record. Valuable results have already been obtained in these experiments, and planters would do well to study carefully and make use of these results in practice.

10. The report indicates that little has been done in the matter of agricultural instruction among small proprietors. The determination of a suitable policy of agricultural instruction for the people and conditions of St. Vincent and the provision of the necessary funds for putting such policy into practice are matters that should receive the early consideration of Government.

11. The production of pedigree cotton seed has been successfully carried on during the year by the Cotton Research Officer of the Empire Cotton Growing Corporation, Experiment Station in Kingstown. Further attempts are being made to increase the yielding capacity of the standard variety V. 135, and early indications promise success. Other work of special interest to St. Vincent undertaken by the Station includes the production of a strain of V. 135 with red pigment in the stem and leaves and having at the same time all the other characters of V. 135. Breeding work has also been initiated to produce a hybrid between V. 135 and the Montserrat strain having lint of the quality of the better strain but being more suitable to St. Vincent conditions for commercial planting in the event of a decline in the demand for longest staple strains of cotton."

ALBAN WRIGHT,
Administrator.

31st December, 1936.

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REPORT ON THE AGRICULTURAL DEPARTMENT, ST. VINCENT,

FOR THE YEAR ENDED DECEMBER 31st, 1935.

SECTION I.

Weather Conditions.

Weather conditions during 1935 were not in any way abnormal, and were quite favourable to most crops. The rainfall at the Botanic Gardens was 97·35 inches whereas the average for the last 42 years is 102·28 inches. Rain fell on 277 days at the Botanic Gardens and on 269 days at the Experiment Station. The distribution of rainfall in the various months was normal and although there were heavy rains, there were none as heavy and destructive to freshly cultivated fields as some which occurred during the previous year. The wet season started fairly early in May and terminated rather earlier than usual. Tables of meteorological observations are included as an appendix to this report.

General.

A further slight recovery during the year 1935 from the effects of the world's economic depression is indicated by slight increases in the values of imports and exports compared with those of the previous year. Imports valued at £171,392 and exports valued at £132,004 were higher than those of 1934 by £8,357 and £2,171 respectively. The revival of the cotton industry, due to an improvement in the Sea Island Cotton market and the expansion of the Banana industry are valuable developments which took place during the year but they will not effect increases in export figures until 1936. The chief exports of the Colony and the export values for the last three years are given in Table I.

TABLE I.

		Quantities exported.			Values exported.		
		1933.	1934.	1935.	1933.	1934.	1935.
					£	£	£
Arrowroot Starch	lb.	4,589,435	6,526,003	6,609,856	55,510	75,044	76,668
Sugar	tons	850	750	725	8,162	5,979	6,406
Syrup and Molasses	gals.	278,528	269,233	148,357	11,624	11,218	6,182
Rum, proof	,,	9,832	5,761	5,468	1,475	908	641
Cotton, Sea Island	lb.	160,792	204,519	205,459	8,107	9,346	9,947
Cotton, Marie Galante	,,	78,508	53,907	38,604	1,619	1,123	804
Copra	,,	2,149,641	2,015,675	840,602	8,978	6,551	3,418
Coconut	no.	17,713	979,988	3,391,582	38	2,538	10,215
Cocoa	lb.	100,230	94,758	97,242	1,141	894	915
Bananas	stems	431	458	5,837	37	46	475
Cassava Starch	lb.	681,761	480,587	778,059	3,110	3,081	4,124
Groundnuts	,,	47,334	12,048	15,282	292	83	98
Nutmegs	,,	27,342	21,544	30,240	342	269	378
Mace	,,	6,015	5,044	6,796	301	210	283
Maize	,,	1,884	34,350	4,261	8	109	25
Peas	,,	120,658	60,274	106,872	754	377	624
Limes	no.	596,629	1,183,219	695,570	219	198	166
Plantains	stems	—	—	—	181	484	295
Sweet Potatoes	bags (150 lb.)	7,909	9,868	9,150	2,186	3,152	2,294
Yams	lb.	—	—	—	83	160	168
Tannias	,,	—	—	—	519	607	477
Cattle	no.	70	19	22	391	108	135
Goats	,,	2,642	2,372	2,114	873	633	758
Poultry	,,	—	—	—	820	770	687
Pigs	,,	2,637	2,174	2,390	3,422	3,705	3,954
Sheep	,,	756	800	958	408	438	485
Asses	,,	150	103	45	206	127	85
Horses	,,	7	9	2	223	333	55

Planters in St. Vincent are indeed fortunate in being able to grow a variety of crops, and also in having a number of annual crops so that it is possible (within limits) to change from one crop to another according to the prevailing market conditions. The market for Arrowroot, the chief crop, was not seriously affected by the events of the last six years, and although markets for some of the other crops were seriously affected, the island now appears to have a fairly prosperous future. There are, however, one or two areas chiefly owned by peasants, where the choice of crops is limited, and where it is impossible, at present, to grow a satisfactory "money" crop. These areas are now chiefly planted with Sweet Potatoes or Cotton and are referred to again in this report in the remarks on Sweet Potatoes.

Arrowroot Industry.

The 1934-1935 Arrowroot crop was reaped under very favourable weather conditions. Rainfall was moderate and there was sufficient to keep the ground in such a condition that it could be easily dug, but not enough to cause much loss of starch by the springing of the mature rhizomes. The reaping season was a long one and the record production of the starch of the previous year was exceeded by about 761,000 lb.

The exports of Arrowroot starch for the year amounted to 6,609,856 lb., an increase of 83,853 lb. over the 1934 exports. The total exports of starch for the last ten years are given in Table II.

TABLE II.

Year.	Arrowroot. lb.	Value. £	Cassava. £	Value. £
1926	3,291,553	45,807	443,075	4,077
1927	3,195,487	53,309	543,681	4,904
1928	3,870,420	64,508	392,610	3,272
1929	3,573,759	59,563	551,512	4,595
1930	3,590,348	59,019	562,327	4,688
1931	3,532,327	44,915	587,071	3,662
1932	3,704,833	47,524	518,888	3,241
1933	4,589,435	55,510	681,761	3,110
1934	6,526,003	75,044	480,587	3,081
1935	6,609,856	76,668	778,059	4,124

There was again an increase in the amount of starch exported to the United States of America. Each year since 1932 this country has purchased considerably more than half of the starch sold. The starch shipped to the United States is now chiefly of the higher grades while that shipped to the United Kingdom is chiefly of the lower. The position of two years ago is thus reversed. Exports of starch to the various countries during the last six years are recorded in Table III.

TABLE III.

Countries.	1930. lb.	1931. lb.	1932. lb.	1933. lb.	1934. lb.	1935. lb.
United Kingdom ...	1,496,330	1,017,193	1,122,621	1,523,663	1,794,125	1,764,186
U. S. America ...	1,084,536	1,980,809	2,036,728	2,455,858	3,534,071	3,954,400
France ...	58,741	31,115	106,415	230,160	142,410	212,800
Canada ...	255,083	246,956	258,497	193,557	370,838	404,064
Barbados ...	378,441	38,945	11,877	8,492	98,748	15,348
Germany ...	60,322	13,920	47,358	78,814	63,628	87,264
Trinidad ...	31,856	27,479	873	6,720	384,188	61,291
Holland ...	138,356	112,311	80,413	51,520	36,739	57,120
Antigua ..	14,941	24,937	8,212	5,835	15,024	19,926
Jamaica ...	7,083	16,026	12,077	12,000	2,400	7,200
British Guiana ...	...	...	...	...	52,720	19,309
Other Countries ...	64,659	22,636	19,762	22,816	31,112	6,948

The area planted with Arrowroot during 1935 was estimated to be about 3,700 acres. The acreage was influenced in some degree by a revival in the Sea Island cotton market. As good cotton land is usually good arrowroot land an improvement in the cotton market in 1936 would probably further decrease the arrowroot acreage, especially where land is owned by peasants. In spite of this influence, however, the area planted for the 1935-1936 crop was probably increased very slightly. Two or three estates increased their acreage considerably but on most of the larger estates the area suitable for the crop is limited, and to increase the acreage would not be economic.

Manuring to obtain larger yields per acre is now receiving much greater attention of both planters and peasants. The manurial experiments reaped by the Department during the year proved conclusively that nitrogen was the limiting factor in the production of rhizomes at four different centres and that dressings of potash and phosphate may cause a reduction in yield. The use of sulphate of ammonia and other nitrogenous manures is therefore being encouraged, and until more is known concerning the interactions between nitrogen and the other elements growers are being recommended to use no artificial potassic or phosphatic manures.

The expansion of the industry during the last few years which has been brought about by increasing acreage and by increasing the yield per acre has not been accompanied by sufficient improvements or enlargements of the factories. It has therefore been necessary to start manufacturing starch very early in the season and to finish late, at which times the percentage of starch in the rhizomes is not as great as during the middle of the season. In 1935, however, many estate owners endeavoured to increase the output and efficiency of their factories by erecting new machinery and equipment, and additional alterations are contemplated in 1936. The most important improvements carried out consisted of the erection of more efficient washing and grating apparatus to increase both the quantity and quality of the starch extracted. Greater attention is being paid to the settling tables, and on some estates good quality starch is now being extracted from "madungo" which was formerly a waste product.

A small model factory equipped with the most modern machinery to eliminate hand-labour as much as possible is being erected on an estate on the windward coast. It is not known definitely whether some of the machinery will be suitable for dealing with arrowroot as the washing of coarse and fine "bitte" present great difficulties. It is hoped that the experiment will be successful especially as the experience and information gained will probably

benefit not only the owners of that particular estate, but of every estate in the island.

Field experiments on arrowroot are described in Section II of this report.

Cotton Industry.

Sea Island.

1934–35 Crop. The year 1935 differed from the three or four years preceding it, in that it commenced with no accumulation of stocks of Sea Island cotton lying unsold. This change in the situation was undoubtedly due largely to the activities of the West Indian Sea Island Cotton Association.

The picking of the 1934–1935 cotton crop was begun in the last week of December 1934 and was continued until April 1935 under favourable weather conditions, although in some districts stainers became very prevalent and did a considerable amount of damage. On some estates on the north windward coast stainers appeared early in January. In this district migration appears to take place annually from the large numbers of *Sterculea Caribaea* trees in the neighbourhood of the Soufrière. Although there were also one or two other smaller centres of severe infestation on the windward side of the island, other windward districts and the leeward side of the island were hardly affected and most of the cotton was picked before any real harm was done. In some of the badly infested areas about two-thirds of the cotton picked was stained, but on some estates the proportion of stained cotton was only about 5%. The average proportion of stained cotton to white for the whole island for the year was 18·9%. This figure is abnormally high as may be seen by comparing it with the records of previous years.

TABLE IV.

Crops.	Area planted Acres.	Weight of lint, lb.	Weight of lint per acre lb.	Per cent stained to white.
1922–23	3,562	575,640	162	9·63
1923–24	3,387	473,248	139	11·55
1924–25	3,294	449,295	137	13·43
1925–26	4,893	585,483	120	12·17
1926–27	6,156	507,240	82	22·71
1927–28	3,364	328,188	97	17·44
1928–29	3,386	263,808	79	19·19
1929–30	1,758	262,382	150	6·78
1930–31	3,955	605,280	153	6·69
1931–32	1,802	209,505	116	7·60
1932–33	669	85,852	122	6·26
1933–34	1,216	99,750	82	14·76
1934–35	1,464	173,735	119	18·92
1935–36	3,540	...	...	...

Pink boll worm (*Platyedra gossypiella*) was very rarely found during the main picking season, but it became slightly more common later. No incidence of cotton caterpillars (*Alabama argillacea*) was reported or recorded.

The area planted for the 1934–1935 crop according to the returns of growers was 1,464 acres. Lint production was 146,091 lb. white and 27,644 lb. stained, a total of 173,735 lb., representing a yield of 119 lb. per acre. All lint was shipped on consignment to the English market and all was sold before November. Prices ranged from 14½d.–16½d. but most cotton was sold at 15½d. —16d. Export figures are given in Table V.

TABLE V.

Year.		Export of lint, lb.	Value £.
1926	...	588,793	63,158
1927	...	446,274	39,204
1928	...	349,246	28,549
1929	...	282,903	24,261
1930	...	256,167	30,377
1931	...	456,089	25,463
1932	...	148,860	8,592
1933	...	160,792	8,107
1934	...	204,519	9,346
1935	...	205,549	9,947

1935–36 Crop. Prior to 1929 the planting of Sea Island cotton was usually commenced on June 1st. In that year, on the recommendation of the Commissioner of Agriculture, growers agreed to postpone planting for three months, and the first of September was fixed by Government to be the first day of planting from 1929 until 1934 inclusive.

In 1935 a number of growers petitioned Government to allow planting on August 1st and, finally, planting was allowed on August 16th. The arguments put forward in support of the change were that :—

(*a*) Cotton planted in October produced very poor yields.

(*b*) Owing to the shortage of labour a sufficiently large acreage could not be planted in September.

(*c*) Cotton trees maturing during the dry season did not produce sufficiently heavy yields, and the last bolls formed failed to open properly.

There is no doubt that fields planted during the first two weeks in September are generally more productive than those planted later and that those planted in October produce very poor yields, but the reason for this is partly due to the fact that the best fields on an estate are usually planted first and the worst fields left until later. If the first two weeks in September are actually the optimum time it is reasonable to suppose that planting should be allowed during the last two weeks in August so that the planting season would be distributed around the optimum—both before and after.

The dangers of planting too early, however, must not be overlooked. Since 1929 when the planting date was changed to September 1st reports on the quality, moisture content and other characters of the lint have been very favourable and there has been an absence of gin-cutting. Records indicate that the change has not reduced the yield obtained per acre, but that it has effected a reduction in the proportion of stained cotton to white. (See Table IV). When bolls mature during the wet season, boll rotting and shedding are very common and conditions are less favourable for the production of white lint. Cotton planted on September 1st normally begins to burst its bolls in the middle of December at about which time the wet season usually terminates.

Cotton caterpillars (*Alabama argillacea*) have caused an almost negligible amount of damage since 1929 although previously they had been a serious pest. It is thought that the adult moths of this caterpillar usually appear in St. Vincent in July, August or September each year and that when cotton is not planted until September they find no cotton plants on which to breed. The effect of the planting season on the incidence of cotton stainers and pink boll worm is not known.

Growers in St. Vincent have recently been very fortunate, compared with some of the neighbouring cotton growing islands, in the quality of the lint produced, and in the low incidence of insect pests, particularly pink boll worm,

and any large departure from the custom of the last few years should be undertaken only with great caution.

In 1935, the close season for cotton in St. Vincent was from June 1st to August 15th. Planting was therefore commenced on August 16th and was continued until the beginning of October. Owing to improved market conditions the area planted was greatly increased and, according to growers' returns, was 3,540 acres, or 2,076 acres more than the previous year. The areas planted by planters and peasants are given in Table VI.

TABLE VI.

				Acres.	Acres.
2,201	Peasants	St. Vincent	...	1,698	
241	,,	Bequia	...	129½	
13	,,	Battawia	...	20½	
2,455					1,848
23	Large Growers	St. Vincent	...	1,613½	
2	,, ,,	Grenadines	...	79	1,692½
25					3,540½

The germination of the seed was excellent and very good stands were usually obtained. Fungus diseases (probably caused by a species of *Rhizoctonia*) and mole crickets were very destructive in some fields.

The manuring of cotton received much more attention than in previous years and large numbers of peasants as well as planters applied varying quantities of sulphate of ammonia with or without an additional application of cotton seed meal when the plants were about 4—6 weeks old. Growth throughout the growing period was very good, and in some fields where cotton had been planted in August under rich conditions plants grew to a height of about nine feet. Such rank growth is usually not accompanied by a heavy yielding capacity and it would seem preferable to plant only poorer fields before the last week in August.

The months of November and December were much drier than usual and the effects of the dry season were apparent about two weeks or so earlier than they normally appear. The effects of planting two weeks earlier therefore cannot be fairly judged.

Two manurial experiments laid down by the Department during the year and reaped during 1936 are described in Section II of this report.

A meeting of the West Indian Sea Island Cotton Association which was arranged to take place in St. Vincent in November, was postponed until January.

Marie Galante.

The acreage returns for Marie Galante Cotton for the year 1935-36 are given in Table VII.

TABLE VII.

			Acres.
146	Peasants—Union Island	...	458
43	,, —Canouan	...	83
2	Large Growers—Grenadines	...	180
	Total		721

Export figures and values for the last three years are given in Table I.

Sugar and Syrup Industry.

Sugar Industry.

The area under sugar-cane during 1935 was estimated to be 1,800 acres, of which about 650 acres were grown for the production of sugar and 1,100 acres for syrup. Although the yield of cane per acre varies considerably, it is generally fairly low and on the syrup estates the average yield is probably not more than 15 tons of cane or 300 gallons of syrup per acre. The wide variations in yield are no doubt partly due to the different physical soil and climatic conditions under which cane is grown, but both varietal experiments and manurial experiments are badly needed to ascertain whether yields could be improved. The appointment of a Specialist Officer (Sugar) has made possible the laying down of such experiments in 1936.

The manufacture of sugar was continued as usual by the only modern factory in the island. Productions amounted to 1,450 tons of sugar and 28,447 proof gallons of rum of which 725 tons of sugar and 7,712 proof gallons of rum were exported to the United Kingdom. During 1935, the owner of this factory obtained technical advice from a firm of sugar technologists with a view to increasing the efficiency of the factory.

The quantities and values of exports of sugar-cane products are given in Table VIII. In the last column of this table 300 gallons of syrup have been assumed to be equivalent to one ton of sugar.

Syrup Industry.

The quantity of syrup manufactured in 1935 which was available for export probably amounted to about 310,000 gallons. The quantity actually exported, however, was only 148,357 gallons, and at the end of December a surplus of about 130,000 gallons was lying in St. Vincent unsold. The reason for this was that Barbados produced a much larger quantity of syrup than was expected, and buyers apparently purchased most of their requirements from that island.

In November, 1935, with the aid of a loan provided from the Colonial Development Fund, a Crop Specialist (Sugar) was appointed to investigate the causes of variations in quality of St. Vincent Syrup, and to introduce new methods in the the process of manufacture in order to standardise the quality as much as possible. When this has been accomplished it would be advisable to reduce variations still further by blending the syrups from the different estates.

TABLE VIII.

Year.	Sugar lb.	Value £	Syrup Gallons.	Value £	Total Value.	Exports calculated as tons sugar.
1926			337,099	16,523	16,523	1,123
1927	839,000	6,947	171,063	10,496	17,443	945
1928	2,081,408	14,193	167,044	9,471	23,671	1,486
1929	2,408,000	14,095	287,941	12,562	26,671	2,035
1930	1,834,560	9,209	183,786	7,360	16,569	1,431
1931	1,222,000	5,100	222,057	8,380	13,480	1,240
1932	448,000	1,900	164,040	5,994	7,894	1,080
1933	1,904,000	8,162	278,528	11,624	19,786	1,778
1934	1,680,000	5,979	269,233	11,218	17,197	1,647
1935	1,624,000	6,406	148,357	6,182	12,588	1,219

Coconut Industry.

The area under coconuts is estimated to be about 5,300 acres. The price of copra, which improved slightly towards the end of 1934, advanced much further in 1935. Prices in London rose from £10. 0. 0 in December, 1934 to £13. 12. 6 per ton in February, 1935, and although they varied between £11. 5. 0 and £14. 15. 0 during the remainder of the year, the tendency was for them to become more firm. In spite of this increase, the shipping of whole nuts was continued on a larger scale and practically three-quarters of the crop was disposed of in this way. Shipments of whole nuts to the United States of America and to Canada were 2,317,840 nuts and 1,046,900 nuts respectively. The usual price obtained increased from about $12.00 per 1,000 f.o.b. St. Vincent to $14.00 per 1,000 later in the year. At these prices the purchaser provided bags and twine and also a man to do the selecting. The nuts produced in St. Vincent are excellent in quality and there is no difficulty in supplying nuts of the standard required. In most cases only the culls were converted into copra which was shipped either to Trinidad or Barbados.

The exports of nuts increased from 979,988 valued at £2,538 in 1934 to 3,391,582 nuts valued at £10,215 in 1935, whereas the exports of copra declined from 2,015,675 lb. valued at £6,551 to 840,602 valued at £3,418. The total value of coconut exports during 1935 was £13,633 which is a record for the island. Export figures for the last ten years are given in Table IX.

TABLE IX.

Year.	Coconuts.		Copra.		Total Value £.
	Number.	Value £.	Pounds.	Value £.	
1926	20,463	102	762,563	9,826	9,928
1927	11,383	52	1,198,441	10,083	10,135
1928	26,703	113	1,505,093	12,543	12,656
1929	118,500	502	1,879,558	11,396	11,898
1930	66,418	273	1,810,167	11,312	11,585
1931	88,185	366	1,842,477	7,755	8,121
1932	72,130	281	2,227,631	11,426	11,707
1933	17,713	38	2,149,641	8,978	9,016
1934	979,988	2,538	2,015,675	6,551	9,089
1935	3,391,582	10,215	840,602	3,418	13,633

Cassava Industry.

The exports of cassava starch during 1935 were 778,059 lb. valued at £4,124 or nearly 300,000 lb. more than exports during 1934. (See Table II). This increase in exports was caused by the selling of stocks accumulated from previous years, and not by an expansion of the industry. In fact during 1935 the production of cassava starch was considerably decreased owing to the unremunerative prices, and the area replanted for the 1936 crop was still smaller.

The question of producing cassava starch for the Canadian market was discussed with the Trade Commissioner in Canada for the West Indies (Eastern Group) during his visit to St. Vincent. Canadian buyers purchase enormous quantities of starch from the Far East and it appears that they would not be very interested in the small quantities St. Vincent is now producing. The price offered is not likely to exceed $2\frac{3}{4}$ to 3 cents per pound and this is believed to be too low to encourage an expansion of the industry. Cassava starch is exported chiefly to Trinidad and Barbados, and the price obtained usually varies between 3 and 4 cents per pound.

Banana Industry.

The expansion of the area under bananas to produce fruit for export was continued very slowly during 1935. The acreage increased from about 230 acres in January to 550 acres at the end of December. Very little planting could be carried out during the dry season, and the shortage of suitable planting material continued to be a limiting factor on most estates, especially on the leeward side of the island.

The importance of affording adequate protection from wind was not sufficiently realised at first, and early in the year a considerable amount of damage was caused by high winds. In some fields a large number of plants were blown down and the trees remaining later produce fruit of very low grade. On those estates where very little cultivation was done, growth of the plants was considerably retarded.

The first shipment of fruit was made on July 31st,—earlier than was expected, owing to an offer made by the Canadian Banana Company to accept less than the minimum quantity specified in the contract.

Exports of fruit to the Canadian Banana Company amounted to 5,770 stems equivalent to 3,840 count bunches. The percentage of counts was 66·5. Total export quantities and values for the year are given in Table I.

The appointment of the Instructor for the Banana Industry which terminated on July 15th, was renewed by Government on the condition that in future his salary and travelling allowance would be reimbursed by the Association. Two Field Assistants were also appointed temporarily on the same conditions.

In January 1935 two Committees were appointed by the Banana Association to visit all possible banana growing areas, and to make recommendations to the Association with regard to the improvement of the roads necessary for the conveyance of fruit. The Association later forwarded the recommendations to Government. The Instructor for the Banana Industry and the Agricultural Superintendent were appointed on both Committees.

Panama Disease. The incidence of Panama disease on the leeward side of the island was very low, only about three stools having been found and destroyed.

To protect slightly infected districts, the worst area on the windward side of the island was declared to be an "infected area" under the Plant Protection Ordinance, and the removal of parts of banana plants from that area to any other area was prohibited. On the windward side of the island several hundred diseased plants were destroyed by local labour under the direction of the Instructor for the Banana Industry and supplies of P.D.K. oil were distributed to all persons who undertook the destruction of plants on their own land.

Cacao Industry.

The exports of cacao during the year 1935 amounted to 97,242 lb. valued at £915, and were slightly more than the average for the three previous years. (See Table X).

Owing to the low yields and unremunerative prices obtained, the interest in the crop continues to diminish and on most estates fields receive little or no attention.

The area under cacao in 1931 according to census returns was 753 acres.

As the conditions suitable for growing cacao are very similar to those required for bananas, the development of the banana industry has been responsible for a considerable diminution in the cacao acreage, especially during 1935. The area at the end of the year was estimated to be about 500 acres.

TABLE X.

Year.	Weight, lb.	Value £.
1926	174,599	2,461
1927	135,490	2,267
1928	179,918	2,998
1929	156,405	2,928
1930	180,373	3,761
1931	146,990	2,390
1932	84,679	1,332
1933	100,230	1,141
1934	94,758	894
1935	97,242	915

Minor Industries.

Maize.

The production of maize during 1935 was again small, and most of what was grown was for home consumption. Less than two tons were exported. (See Table I).

No maize was purchased by the Government Cotton Ginnery during 1934 or 1935 owing to the heavy losses sustained in the two previous years. Large quantities of corn meal are imported into St. Vincent annually for human consumption as the meal produced locally is not as palatable. The possibility of manufacturing a higher quality local product of the standard required by local consumers needs investigating.

Groundnuts.

The exports of groundnuts during 1935 amounted to 15,282 lb. valued at £98, or about 3,000 lb. more than in 1934. (See Table I). They were shipped chiefly to Trinidad or Barbados.

There are now no estate producers as the prices obtained except under unusual circumstances, are considered to be too low, and the only estate owner who grew them in 1934 has discontinued because fields on which groundnuts are planted erode very badly during heavy rains.

Sweet Potatoes.

This crop is chiefly grown by peasants and in a few districts where there are no syrup or arrowroot factories peasants have had to rely on sweet potatoes as their chief money crop. The exports during 1935 were 9,150 bags (of approximately 150 lb.) valued at £2,294, and 98% of these were shipped to Trinidad. (See Table I). The production of larger quantities of ground provisions in neighbouring islands has seriously affected the St. Vincent market and large numbers of producers who have to transport sweet potatoes many miles into Kingstown receive for them less than five shillings per bag.

Sweet potatoes are usually grown on poor lands, and as the crop is one which allows considerable erosion to take place during heavy rains, the lands tend to become poorer each year. In those districts where no syrup or arrowroot factories are available for peasants' use, (*e.g.* on parts of the leeward coast) the only other possible cash crop is cotton which also encourages erosion. In consequence of this, large areas have become so poor and eroded that their cultivation produces very small returns. The best economic way of building up the soil in such cases is to grow crops which keep the soil covered with vegetation during the rainy season so that erosion will be checked, and the only cash crops which at present can be recommended for this purpose are arrowroot or sugar-cane. The erection of factories is therefore considered to be essential to prevent these areas becoming totally unfit for economic cultivation.

Pests and Diseases.

Cotton Pests.

These have been discussed under Cotton.

Arrowroot Leaf Roller. (*Calpodes ethlius*).

The total amount of damage caused by this pest in 1935 was not very great. The first attack appeared in May in a ratoon field close to the sea on Grand Sable estate. Small isolated patches were defoliated but there was a quick recovery.

A field of young plants on Spring estate was severely attacked during August and September.

The incidence of the pest in other parts of the island was fairly low. The butterflies prefer to lay their eggs on young foliage, and in consequence of this, plants which are at a certain stage in the production of new foliage as the result of an application of nitrogenous manure are often attacked much more than those in unmanured fields.

Banana Borer. (*Cosmopolites sordidus*).

This insect causes comparatively little damage in St. Vincent.

Sugar-cane Moth Borers. (*Diatræa spp.*).

During 1935 canes were examined in the factory yards of several estates in order to estimate the amount of damage caused by moth borers. The figures obtained which are given in Table XI indicate that there was a higher degree of infestation than that recorded by Dr. Myers in 1934. (See appendix to 1934 Report). In the samples examined by Dr. Myers, the percentage of internodes infested was 8·8 on the leeward estates and 6·1 on the windward, whereas the percentages determined during 1935 were 16·0 and 16·2 respectively.

TABLE XI.

Estate.	Total joints.	Joints bored.	% Joints bored.
Mount Bentinck ...	4,199	731	17·4
Spring ...	1,891	256	13·5
Pembroke ...	1,792	345	19·2
Rutland Vale ...	1,759	233	13·2
Total ...	9,641	1,565	—

Artificial Manures.

Imports of artificial manures into St. Vincent are increasing steadily from year to year as may be seen in Table XII. The first up to date manurial experiments carried out in St. Vincent were laid down on arrowroot in 1933, and the results obtained in 1934 indicated that applications of sulphate of ammonia produced large increases in the yield of rhizomes. In 1934 the imports of sulphate of ammonia were 118 tons more than in 1933 and imports in 1935 were 210 tons more than in 1934, or two and a half times the imports during 1933.

TABLE XII.

Tons (long).

	Sulphate of ammonia.	Other nitrogenous manures.	Super Phosphate.	Sulphate of Potash.	Muriate of Potash.	Mixed Manures.	Total.
1931	164·1	58·8	4	21	—	11	258·9
1932	199·6	50	4	9	—	75	337·6
1933	206·6	150	—	—	—	20·5	377·1
1934	325	—	·1	1·1	4·5	129·5	460·2
1935	535·7	5·5	4·5	9	—	15	569·7

The countries of origin of the sulphate of ammonia imported are shown in Table XIII.

TABLE XIII.

Countries of origin of Sulphate of Ammonia imported.

	United Kingdom.	Canada.	United States of America.	Total.
	Tons.	Tons.	Tons.	Tons.
1931	—	32	132·1	164·1
1932	61·1	138·5	—	199·6
1933	30·1	5·5	171	206·6
1934	257	23	45	325
1935	127·7	20·5	387·5	535·7

SECTION II.

Botanic Gardens.

The existence of large numbers of closely planted trees in the Botanic Gardens resulted in too much overhead shade and provided conditions very unfavourable for the growing of ornamental shrubs. A number of mango and other unimportant trees were felled or cut back during the year to provide space for planting more ornamental plants, and to allow more of the existing ornamental trees to be seen.

Two plants of *Victoria regia* were established in the pond, and a new pipe line was laid down to supply the pond with a better water supply. A nursery was re-established in the Gardens for the purpose of raising budded citrus plants and a limited number of ornamentals for distribution in 1936.

Importations.

The following seeds and propagating material were imported by the Department during 1935.

(1) From the Botanic Gardens, British Guiana, seeds of *Victoria regia*.

(2) Through the Commissioner of Agriculture,

(*a*) seeds of tonka beans from Trinidad.
(*b*) onion seed from Teneriffe.
(*c*) Early Patna cauliflower seed from India.
(*d*) budwood of Valencia, Washington Navel and Jaffa oranges, and
(*e*) budwood of Marsh Seedless, Foster and Duncan grapefruit.

The following plant material imported by private individuals was examined under the authority of the Plants Protection Ordinance, 1935 :—

Vegetable and other Seeds	...	115 parcels.
Ornamental and other Plants	...	56 parcels.

The contents or part of the contents of several parcels of plant material were destroyed. The reasons for destruction were that the material was either in an unhealthy condition, or was growing in soil.

Nurseries and Plant Distribution.

The plants and propagating material distributed during the last three years are given in Table XIV.

TABLE XIV.

	1933.	1934.	1935.
Plants.			
Tomato	30,400	29,800	12,500
Onion	1,300	2,800	409
Cabbage	300	2,400	1,450
Lime grafted	1	4	6
Mango „	418	195	107
Grapefruit budded	345	99	98
Orange „	181	5	104
Avocado pears	6	1	—
Coconut	19	2	21
Papaw	—	150	—
Pineapple	172	22	48
Decorative (Misc.)	182	139	478
Economic „	58	—	13
Cuttings.			
Sugar-cane	26,050	12,300	8,900
Sweet Potato	8,800	—	—
Rhizomes.			
Arrowroot	6,050 lb.	5,250 lb.	9,867 lb.
Seeds.			
Groundnut	23 „	22 „	8 „
Cover crops	10 „	320 „	20 „

Citrus.

The budded citrus plants produced during 1935 were very much superior to those produced in previous years. The seeds for the stocks were obtained from known trees, and a rigid selection of the seedlings was made when transplanting into the beds for budding. There were considerable improvements in the technique of budding and in the later care of the plants, so that all the plants distributed were of a high standard quality. By distributing such trees it is hoped that growers in St. Vincent will be able to produce at least enough citrus fruit to meet the demand for local consumption.

Mangoes.

The top-working of mangoes for private individuals was discontinued at the beginning of the year, as the possibilty of being able to develop a large

export market for mangoes is open to doubt. The production of grafted plants for sale, however, was continued.

Sugar-cane.

Most of the sugar-cane cuttings distributed were of the variety B. 2935 which is being strongly recommended for estate trial. It is possible that this variety will prove to be an excellent substitute for the variety Ba. 11569.

The Giant Toad.

Following the recommendations of Dr. J. G. Myers, Biological Control Research Officer, who visited St. Vincent in 1934, over three hundred live specimens of the Giant Toad (*Bufo marinus*) were imported into St. Vincent during the wet season of 1935. The toads were received in several batches from Trinidad by arrangement with the Commissioner of Agriculture, and liberated in St. Vincent at five different centres, namely:—

(1) The Botanic Gardens.
(2) Brighton Estate.
(3) Cane Grove Estate.
(4) Dumbarton Estate.
(5) Grand Sable Estate.

The introduction appears to have been successful and several hundred young frogs emerged from the pond in the Botanic Gardens before the end of the year.

Live Stock.

No pedigree animals have been kept by the Department for the improvement of live stock in the Colony for a number of years. A few pedigree animals are however occasionally imported by estate owners, and, through the Commissioner of Agriculture, the Department arranges to purchase animals for private individuals at the Trinidad Government Stock Farm Annual Sale. During 1935 two pedigree Berkshire pigs and a Zebu cow were purchased by such arrangement.

The number of animals existing in the Colony at the time of the 1931 census was as follows :—

Horses	357	Cattle	6,070
Mules	169	Sheep	2,205
Asses	2,365	Goats	5,813
Swine	6,182		

Since 1931, however, the more general use of motor transport has been responsible for a considerable reduction in the number of draught animals.

Arrowroot Experiments.

Reports by the Agricultural Assistant on arrowroot experiments carried out during the last two seasons are given below.

Defoliation Experiments.

The only serious pest of arrowroot in St. Vincent is the leaf-roller *Calpodes ethlius*. This caterpillar attacks the young crop and may under favourable conditions completely defoliate the plants. Fortunately the attacks

are seldom very severe or widespread. The pest, however, is serious enough to merit some attention being paid to the possibilities of its control. One of the essentials in the consideration of a control campaign of any pest is an assessment of the amount of damage and so the financial loss inflicted by the pest.

With this object in view an experiment was laid down on a plant field at Union Estate in 1933-34 in which the plants were completely defoliated at the following stages :

(1) $3\frac{1}{2}$ months after planting.
(2) $5\frac{1}{2}$,, ,, ,,
(3) $9\frac{1}{2}$,, ,, ,,

The experiment was laid out in the form of a 5 x 5 Latin Square with plots approximately $\frac{1}{75}$ acre (18 x 32 ft.) in size. The field chosen was located at the base of a steep slope which was all planted on the same date, 12. 6. 33. The light soil of the steep slopes washed badly, and much of it was deposited on the experimental plots below during the heavy rains of the wet season.

The mean yields for the various treatments expressed in lb. per plot are given below.

As there were only three treatments there were two sets of control or no treatment plots but the yields of these two were added together and the mean taken.

Treatment		1	2	3	Control.
Yield per plot	...	186·8	195·0	210·6	241·4
Percentage of control	...	77·4	80·8	87·2	100

The effect of treatment was not statistically significant, however, as there were considerable variations between similarly treated plots.

The experiment was therefore repeated at Cane Hall in 1934-35. Plants were completely defoliated at the following different times :—

(1) 2 months after planting.
(2) 4 ,, ,, ,,
(3) 6 ,, ,, ,,
(4) 8 ,, ,, ,,
(5) Control—no defoliation.

The first defoliation was performed when the plants were only 6-8 inches high while the plants in the plots defoliated at 8 months were beginning to show signs of drying down.

The experiment was in the form of a 5 x 5 Latin Square with plots 18 x 32 ft. or approximately $\frac{1}{75}$ acre.

The plan of the experiment with yield in lb. per plot is given in Table XV. The figures in brackets refer to the treatments enumerated above. The analysis of variance is given in Table XVI.

TABLE XV.

(1)	(5)	(4)	(3)	(2)
241	261	197	159	163
(4)	(2)	(1)	(5)	(3)
243	210	211	266	193
(2)	(1)	(3)	(4)	(5)
153	227	147	238	287
(3)	(4)	(5)	(2)	(1)
158	194	227	201	284
(5)	(3)	(2)	(1)	(4)
244	130	154	240	181

TABLE XVI.

Due to	Degrees of Freedom.	Sum of Squares.	Mean Square.	$\frac{1}{2}$ log e (Mean Square).
Rows ...	4	3,246·96		
Columns ...	4	3,968·96		
Treatment ...	4	32,607·36	8,151·84	2·20031
Error ...	12	8,624·48	718·71	0·98614
Total ...	24	48,447·76		Z=1·21417

For P=·01, n_1=4 and n_2=12, Z=0·8443.

The analysis of variance shows that treatment had a highly significant effect on yield. Treatment means in lb. per plot are given below.

Treatment	1	2	3	4	5
Mean Yields	240·6	176·2	157·4	210·6	257·0
Percentage of Control	93·6	68·6	61·1	81·9	100

It has been calculated that a difference between two means, in order to be significant, must be greater than

$$\sqrt{\frac{718{\cdot}71 \times 2}{5}} \times 2{\cdot}179 = 36{\cdot}95 \text{ lb., for P=·05 and N=12.}$$

Conclusions.

1. The defoliation of plants two months old tends to reduce the yield slightly but not significantly.
2. Defoliation when the plants are eight months old has a somewhat greater and significant effect. The loss is about 18% by weight of rhizomes.
3. A much greater loss results from defoliation when the plants are four and six months old. The maximum loss (nearly 39%) was sustained when the plants were six months old.

Discussion.

Under the conditions of this experiment, maximum reduction in the production of rhizomes, or rather in the weight of rhizomes, appears to take place when the plants are defoliated between four and six months with an average loss of about 35%. It is known that rhizomes are seldom formed before the plant enters the flowering stage when about three and a half to four months old. This is probably the beginning of the period of greatest photo-synthetic activity and storage of starch and the destruction of foliage would practically suspend these functions. Also much of the starch which has already been accumulated would probably be used up in subsequent growth.

Prior to the flowering period the plants are quite small and little foliage is developed so that the retardation as a result of loss of foliage is relatively slight. Again in the later stages when the plant is eight months old or more, growth and the storage of starch have practically ceased so that again relatively little damage is done. It is possible that in the later stages defoliation may result in the "springing" of rhizomes if weather conditions are favourable for growth but this took place in neither experiment.

The leaf roller however seldom attacks arrowroot at so late a stage, as the foliage then appears to be too tough and unpalatable. It is characteristic

of this pest that young dark green foliage is invariably attacked in preference to yellowish green foliage of even the same age.

If it is assumed that a normal starch yield is about 10 barrels per acre, and that defoliation does not increase the relative fibre content of the rhizomes, a loss of 35% by weight of rhizomes is equivalent to a loss of about $3\frac{1}{2}$ barrels of starch per acre.

It must be pointed out, however, that it is not known how far the results of artificial defoliation are comparable with the effects of defoliation by caterpillars. It is possible that the artificial defoliation which was performed in one operation may induce considerable shock to the plants as compared with the more gradual defoliation by insects.

Spacing Experiment.

In the annual Report for 1933 the results of an experiment in which arrowroot was planted at four different distances between 6″ x 6″ and 18″ x 18″ showed that plots planted 6″ x 6″ produced the highest yields. In 1934-35 a similar experiment was laid down at the Experiment Station in which the lower range was extended to 3″ x 3″ (A) and the upper limited to 12″ x 12″ (D), with two intermediate distances 6″ x 6″ (B) and 6″ x 9″ (C).

The experimental lay-out was a 4 x 4 Latin Square with plots 15 x 20 ft. or approximately $\frac{1}{145}$ acre. The experiment was planted on 26. 7. 34. and dug on 8. 4. 35. The lay-out and the yields in lb. of rhizomes per plot are given in Table XVII and the analysis of variance in Table XVIII.

TABLE XVII.

B	A	D	C
111	176	54	80
A	D	C	B
152	66	90	108
C	B	A	D
101	110	134	67
D	C	B	A
76	96	99	141

TABLE XVIII.

Due to	Degrees of Freedom.	Sum of Squares.	Mean Square.	½ log e (Mean Square.)
Rows ...	3	13·85		
Columns ...	3	879·85		
Treatments ...	3	15,230·35	5,076·78	1·96363
Error ...	6	700·55	116·76	0·07751
Total ...	15	16,824·60		Z=1·88612

For P=·01, N_1=3 and N_2=6, Z=1·1401.

The analysis of variance shows that variations in planting distance had a very significant effect on yield. The yields obtained expressed in lb. for totals of four plots are given below.

Distance	3″ x 3″	6″ x 6″	6″ x 9″	12″ x 12″
Yield	603	428	367	263

The standard error of a difference between two treatment totals is $\sqrt{116{\cdot}76 \times 4 \times 2} = 30{\cdot}6$ lb., and for P=·05 and N=6, a difference greater than 30·6 x 2·447 lb. =74·8 lb. is statistically significant.

The above figures show that plots planted 3″ x 3″ produced yields that were significantly higher than those from any of the other plots. Also plots planted 6″ x 6″ yielded significantly better than plots planted 12″ x 12″.

These results confirm those obtained in 1933–34 and tend to indicate that higher yields of rhizomes are obtained with closer spacing. A yield curve based on these results is practically straight with a uniform slope showing that yield increases uniformly with the number of plants per acre, and it is possible that even closer spacing may lead to higher yields of rhizomes. There are, however, certain practical difficulties and disadvantages which render too close a spacing undesirable. Very close planting of plant fields would require a very large quantity of planting material—for instance plots planted 3″ x 3″ required 145 lb. of planting material per plot whereas those planted 6″ x 6″ and 12″ x 12″ required 38 lb. and 10 lb. per plot respectively. The quantity of material required for planting at 3″ x 3″ therefore is entirely outside the range of practical possibilities as it is equivalent to about 190 baskets per acre. Very close planting has a further disadvantage, namely that as the planting distance is reduced the size of rhizome produced progressively decreases. This in all probability results in a decreased starch content for a given weight of rhizomes as the relative fibre content would undoubtedly increase with the smaller rhizomes. This increased fibre content would also lead to greater losses in extraction and consequently poorer starch yields. It is thought that a planting distance of about 6″ x 6″ would be about the optimum.

The above results have an important practical bearing on the supplying and thinning of ratoon arrowroot fields, operations which are frequently neglected or given only perfunctory attention. It is all too common to see large clusters of very closely growing plants with relatively wide weedy spaces between them. It would appear that more uniform results and better rhizomes would be obtained if serious attempts were made to ensure a more or less uniform spacing of 6″ x 6″.

Time of Application of Sulphate of Ammonia.

In the Annual Report for the year 1934 it was shown that the time of application of sulphate of ammonia was a very important factor in determining the response to this fertiliser. An application of sulphate of ammonia when the plants were from two to four months old resulted in an increase of 22% to 26% over plots receiving sulphate of ammonia at the time of planting.

During 1935–36 an experiment was laid out at Union Estate on a field that had been dug on 17. 5. 35. In this experiment applications of sulphate of ammonia at the rate of 300 lb. per acre were applied at different times and in different doses as follows :—

Treatment 1. 300 lb. per acre three months after planting. (23. 8. 35).

„ 2. 100 lb. per acre three months after planting, and 200 lb. per acre four and a half months after planting. (4. 10. 35).

„ 3. 50 lb. per acre three months after planting, 100 lb. per acre four and a half months after planting, and 150 lb. per acre six months after planting. (15. 11. 35).

„ 4. 300 lb. per acre in twelve weekly applications from 23. 8. 35.

„ 5. 300 lb. per acre six months after planting (15. 11. 35).

„ 6. Control—no manure.

The experiment was laid down in the form of a 6″ x 6″ Latin Square with plots 29 x 30 ft., each plot having a three feet border.

The land on which this experiment was conducted was an old groundnut field, the soil of which is described later under the factorial manurial experiment at Union. The field had suffered from erosion in the past so that the arrowroot was not very good and there was quite a fair percentage of cigars. The response to sulphate of ammonia was usually high and, when the plots were being dug it was very evident that there was a large number of better rhizomes in the plots which had received sulphate of ammonia.

The experimental lay-out, the treatments, (in brackets) and the yields in lb. of rhizomes per plot are given in Table XIX.

TABLE XIX.

(3)	(4)	(6)	(5)	(2)	(1)
251	196	119	161	216	223
(1)	(5)	(2)	(3)	(6)	(4)
281	176	195	205	140	235
(2)	(6)	(1)	(4)	(5)	(3)
298	138	257	231	184	199
(6)	(3)	(5)	(1)	(4)	(2)
201	232	172	262	203	228
(4)	(2)	(3)	(6)	(1)	(5)
344	333	239	140	215	163
(5)	(1)	(4)	(2)	(3)	(6)
270	337	306	259	283	127

TABLE XX.

Due to	Degrees of Freedom.	Sum of Squares.	Mean Squares.	$\frac{1}{2}$ log e (Mean Square).
Rows ...	5	18,185·80		
Columns ...	5	24,140·10		
Treatments ...	5	66,901·75	13,380·35	2·44814
Error ...	20	16,713·60	835·68	1·06155
Total ...	35	125,941·25		Z=1·38659

When P=·01, N_1=5 and N_2=20, Z=0·7058.

The analysis of variance is given in Table XX, and shows that treatment has had a significant effect on yield. The treatment yields expressed in lb. per total of six plots are as follows :—

Treatment ...	1	2	3	4	5	6
Yield ...	1575	1529	1409	1515	1126	865

The standard error of a difference between two treatment totals is

$\sqrt{835{\cdot}68 \times 6 \times 2} = 100{\cdot}14$ lb.

and for P=·05 and N=20, the value of t is 2·086. A difference therefore, must exceed 100·14 x 2·086 lb. =208·9 lb. in order that it may be statistically significant.

It may be concluded, therefore, that

1. All treatment yields are significantly higher than that from treatment 6, i.e., the control or no manure plots.
2. There is no significant difference between the yields from treatments 1, 2, 3, and 4.
3. Treatments 1, 2, 3 and 4 produced yields that are significantly higher than the yield from treatment 5.

Discussion. The results of this experiment tend to confirm previous results and show that the time of application of sulphate of ammonia plays an important part in determining the effect of this fertiliser on yield. Treatment 1, which consisted of an application of sulphate of ammonia at the rate of 300 lb. to the acre three months after planting resulted in an increase of 82% in yield over plots receiving no sulphate of ammonia, whereas the same quantity applied six months after planting produced an increase of only 41·7%. It is evident, therefore, that the arrowroot plant makes far more effective use of the fertiliser at three months than at six or, in other words, the nitrogen requirement is greater at three months. Previous work indicated that applications at the time of planting had a far smaller effect than at from two to four months after planting. Taken together the two sets of results tend to show that the greatest nitrogen requirement is from about two to four months after planting with probably a peak at about three months after planting. In this connexion it is instructive to consider the various stages in the growth of the arrowroot plant. Arrowroot is vegetatively reproduced from a short length of the rhizome, usually the two or three internodes at the proximal end. From these "bits" shoots appear above ground in about a fortnight. Usually a single shoot grows up from each bit and for about three months growth is fairly slow and the habit erect. When the plants are about three months old, or about the beginning of the flowering period, growth is considerably accelerated and in a short time there may be half-a-dozen or more quite large shoots. The top growth of the plant spreads laterally and habit becomes less erect. After the sixth month there is little further growth and the plant starts dying down about the eighth month. The production of rhizomes and the accumulation of starch do not begin before the flowering period. It would appear, therefore, that the period of greatest nitrogen requirement coincides with the period of maximum increase in the size of the plant. When manure is applied at the time of planting it is obvious that some time must elapse before even a small root system is developed so that much of the fertiliser is washed out of the loose sandy soil before it can be taken up. The nitrogen requirement soon after sprouting is probably also partially satisfied by the nitrogen present in the "bit"—the dark green appearance of any young arrowroot field is not at all suggestive of nitrogen deficiency. The requirement for nitrogen increases up to the peak value at about three months after planting and then decreases.

It is possible to explain the results obtained from treatments 2, 3 and 4 if the above nitrogen relationship is accepted. Any large quantity of nitrogen applied later than the third month after planting may be less effectively utilised than at three months and therefore may result in a smaller increase in yield—this effect, of course, would be more pronounced the greater the departure from the optimum date. Dividing the application of 300 lb. of sulphate of ammonia into two or more equal doses, all of which, except the first, were applied later than three months after planting, would probably result in only partially satisfying the maximum requirement at three months. Therefore the better distribution of the manure, although reducing the loss by leaching would hardly produce larger yields than a single application at three months. For instance, the twelve weekly applications of sulphate of ammonia each at the rate of 25 lb. per acre did not produce as high a yield as 300 lb. at three months. Similarly, treatment 3 in which half the manure was applied at six months resulted in a yield considerably lower than either treatments 1 or 2.

In conclusion it is recommended that until further information is available sulphate of ammonia should be applied at the rate of 300 lb. to the acre when the plants are not less than six weeks and not more than four months old. The optimum time would depend largely on weather conditions and the stage of growth of the plants but the application should not be delayed beyond the early flowering stage.

Pen-manure Experiments.

In the Annual Report for 1934, a series of experiments conducted in 1933 and 1934 were described. The treatments were :—

1. Control.
2. Pen-manure (10 tons per acre).
3. Pen-manure (10 tons per acre) + sulphate of ammonia (300 lb. per acre).
4. Pen-manure (10 tons per acre) + sulphate of potash (180 lb. per acre).
5. Pen-manure (10 tons per acre) + superphosphate (270 lb. per acre).
6. Sulphate of ammonia (300 lb. per acre) + sulphate of potash (180 lb. per acre) + superphosphate (270 per acre).

The experiments were continued on the same sites in 1935–36 but the treatments were varied. At Montrose and Grand Sable no further dressings of pen-manure were given while at Diamond and Keartons no manures of any kind were added. In this way it was hoped to obtain information on the residual effects of the various manures. The soils on which the experiments were laid down have been already described (1) and a Table of the profile data reproduced in the Annual Report for 1934.

The yields in lb. of rhizomes per plot and the plans of the experiments which are the same as those of the 1933–34 and 1934–35 experiments are given in Tables XXI and XXII.

TABLE XXI.

Montrose.						*Grand Sable.*					
(3)	(4)	(6)	(5)	(2)	(1)	(3)	(1)	(4)	(6)	(2)	(5)
347	239	246	248	253	254	390	236	326	459	339	383
(1)	(5)	(2)	(3)	(6)	(4)	(5)	(6)	(3)	(2)	(4)	(1)
308	286	197	335	383	200	206	315	302	239	279	209
(2)	(6)	(1)	(4)	(5)	(3)	(2)	(4)	(5)	(1)	(3)	(6)
343	251	174	221	230	219	262	300	224	189	396	419
(6)	(3)	(5)	(1)	(4)	(2)	(4)	(5)	(1)	(3)	(6)	(2)
232	223	184	263	259	242	212	188	197	343	457	261
(4)	(2)	(3)	(6)	(1)	(5)	(6)	(3)	(2)	(5)	(1)	(4)
211	191	248	368	254	280	410	329	168	205	193	237
(5)	(1)	(4)	(2)	(3)	(6)	(1)	(2)	(6)	(4)	(5)	(3)
203	181	209	273	289	359	182	211	401	171	218	328

TABLE XXII.

Diamond.						*Keartons.*					
(4)	(5)	(1)	(3)	(6)	(2)	(6)	(3)	(4)	(1)	(5)	(2)
319	339	298	354	336	369	309	321	316	228	235	328
(6)	(3)	(2)	(4)	(1)	(5)	(1)	(2)	(5)	(4)	(3)	(6)
306	331	370	295	243	360	319	355	348	369	376	281
(3)	(2)	(4)	(1)	(5)	(6)	(5)	(4)	(3)	(6)	(2)	(1)
369	315	365	279	290	392	298	294	341	250	375	290
(5)	(6)	(3)	(2)	(4)	(1)	(2)	(6)	(1)	(3)	(4)	(5)
350	294	414	316	358	376	377	249	294	436	466	428
(2)	(1)	(6)	(5)	(3)	(4)	(3)	(1)	(2)	(5)	(6)	(4)
486	328	397	354	312	276	398	263	373	448	352	424
(1)	(4)	(5)	(6)	(2)	(3)	(4)	(5)	(6)	(2)	(1)	(3)
256	313	434	355	332	340	409	420	345	453	388	370

Analysis of Variance. The analysis of variance of the Montrose and Grand Sable experiments are given in Table XXIII and of the Diamond and Keartons in Table XXIV.

TABLE XXIII.

Due to	Degrees of Freedom.	Sum of Squares.	Mean Square.	½ log e (Mean Square).	Z.
Rows ...	10	22,829·44			
Columns ...	10	70,369·14			
Squares ...	1	11,826·68			
Treatments ...	5	171,459·57	34,291·91	1·76745	1·40866
Interaction ...	5	40,816·90	8,163·38	1·04983	0·69104
Error ...	40	81,978·26	2,049·46	0·35879	
Total ...	71	399,279·99			

For P=·01, n_1=5 and n_2=40, Z=0·6369.

TABLE XXIV.

Due to	Degrees of Freedom.	Sum of Squares.	Mean Square.	½ log e (Mean Square).	Z.
Rows ...	10	16,571·70			
Columns ...	10	73,552·03			
Squares ...	1	1,125·34			
Treatments ...	5	48,622·96	9,722·59	1·13740	0·84881
Interaction ...	5	21,396·08	4,279·22	0·72689	0·43830
Error ...	40	71,242·76	1,781·09	0·28859	
Total ...	71	232,510·87			

For P=·05, n_1=5 and n_2=40, Z=0·4535.

Montrose and Grand Sable.

The analysis of variance shows that treatment had a statistically significant effect on yield but that the various treatments did not produce the same relative results at the two centres. Treatment yields in lb. per total of six plots for the two centres were as follows :—

Treatment	1	2	3	4	5	6
Montrose	2,034	2,099	2,261	1,939	2,031	2,439
Grand Sable	1,806	2,080	2,688	2,125	2,024	3,041
Total	3,840	4,179	4,949	4,064	4,055	5,480

The standard error of a difference between two treatment totals in the Montrose experiment is $\sqrt{3055{\cdot}06 \times 12}$ and a difference between any two treatment totals must exceed $\sqrt{3055{\cdot}06 \times 12 \times 2{\cdot}086} = 399{\cdot}4$ lb. to be statistically significant. The corresponding value for the Grand Sable experiment is 233·5 lb.

As in previous years, the largest responses in both experiments were from plots receiving nitrogenous fertilizers, but the response at Montrose was again

considerably less than at Grand Sable. The complete artificial fertilizer produced an increase of 19·9% at Montrose whereas at Grand Sable the increase was 68·4%.

There was apparently no residual effect from the applications of pen-manure at Montrose but at Grand Sable the effect was well marked and resulted in a significant increase in yield over control of 15·2%. The addition of phosphate and potash did not appreciably modify the residual effect of pen-manure, though at Montrose there were indications that potash had a depressing action. Sulphate of ammonia caused increases in yield, the increase being considerably greater and significant at Grand Sable. The evidence seems to indicate that the residual effect of the pen-manure had a masking effect on the response to sulphate of ammonia as the increase from this treatment was much less than from the complete artificial manure. This effect was also noted in 1933 and 1934 when the response to the dressing of sulphate of ammonia plus pen-manure did not differ greatly from the response to the complete artificial manure though the nitrogen content of the former manurial dressing must have been considerably greater.

It is frequently stated that the use of only artificial fertilizers must in time result in soil impoverishment and decreased fertility. In the above experiments a dressing of a complete artificial fertilizer has been added for three successive years with the following results :

	Percentage increase over control.		
	1933-34	1934-35	1935-36
Montrose ...	22·02	22·5	19·9
Grand Sable ...	25·0	47·5	68·4

These figures do not tend to show any falling off in yield. At Montrose there was a slight decrease in 1935–36 but it was too small to be significant while at Grand Sable there was a progressive increase in yield from year to year. Of course, it is not possible to draw any definite conclusions on this point as the experiments were only conducted for a period of three years. The addition of artificial fertilizers especially nitrogenous, stimulates top-growth considerably and thus makes available a greater quantity of organic matter for incorporation into the soil when digging. If soil fertility is as largely dependent on organic matter content as is usually claimed, the addition of nitrogenous fertilizers would therefore tend to maintain soil fertility.

Diamond and Keartons.

The treatment yields expressed in lb. per total of six plots for the Diamond and Keartons experiments were as follows:—

Treatment	1	2	3	4	5	6
Diamond	1,780	2,188	2,120	1,926	2,127	2,080
Keartons	1,782	2,261	2,242	2,278	2,177	1,786
Total	3,562	4,449	4,362	4,204	4,304	3,866

The analysis of variance in Table XXIV shows that there was a statistically significant effect due to the residual effects of treatments given in 1934–35. There are indications that these residual effects were not quite the same at the two localities but the interaction of treatment and locality was just not significant.

The standard of significance between two treatment totals at Diamond is 321·1 lb. and at Keartons 301·5 lb.

At both centres, therefore, pen-manure exerted a significant residual effect—at Diamond the increase over control was 22·9%. while at Kearton it was 26·9%.

At neither centre did the complete artificial manures have a significant residual effect, though at Diamond the effect was quite pronounced.

Treatments 3, 4 and 5, i.e. pen-manure plus sulphate of ammonia, potash and superphosphate respectively did not differ significantly in their residual effects from that due to pen-manure alone, though at Diamond there are indications that potash tended to reduce the residual effect due to pen-manure, while phosphate had a similar effect at Kearton.

From these experiments it is concluded that under certain conditions pen-manure may have a very appreciable residual effect but it is not possible to estimate the value of this effect as pen-manure had been added to the plots for two consecutive years. On the other hand it does not appear that artificial fertilizers produce an appreciable residual effect though there is no evidence that the use of artificials would accelerate soil degeneration.

1. Agricultural Soils of St. Vincent—Hardy, Robinson and Rodriguez.

Factorial Experiments.

In the Annual Report for 1934 certain arrowroot manurial experiments laid down in 1933 and continued in 1934 were described. It was shown that whereas fertilizing with nitrogenous manures resulted in large increases in the yield of rhizomes on the chief soil types of the arrowroot growing districts, the addition of potassic and phosphatic fertilisers had either no appreciable effect or, in the case of the potash, a depressing action on yield.

As, however, a basal dressing of pen-manure at the rate of 10 tons per acre was applied to all plots receiving manurial treatments in these experiments it was not possible to isolate definitely the effects of nitrogen, potash or phosphate nor was it possible, with the experimental design used, to investigate the interaction of nitrogen, potash and phosphate. In 1935, therefore, two new experiments of the factorial type were laid down. This design, which was developed by the Rothamsted workers, makes possible the investigation not only of the principal effects of various fertilizers but also the interactions of these fertilizers within one large experiment thereby providing a wide range of experimental conditions and so a wide inductive basis for any conclusions that may be drawn.

In the 1935 experiments nitrogen, phosphate and potash were applied as sulphate of ammonia, superphosphate and sulphate of potash respectively in three different quantities or levels, namely; no application, a unit application, and twice the unit application. The three levels of the three manures were combined in all possible ways producing twenty-seven different manurial combinations. These twenty-seven treatments were further subdivided into blocks of nine in such a manner that all main effects and first order interactions were conserved but certain of the second order interactions were confounded with block differences. By this means it was hoped that some part of the soil variation entering into an experimental area of twenty-seven plots, each approximately 1/50 acre in size would be eliminated.

Experimental Sites.

One experiment was laid down at Grand Sable Estate and the other at Union Estate.

The *Grand Sable* soil is described (1) as a *Recent Volcanic Ash* consisting chiefly of black ash and sand deposited during the more recent eruptions of the Soufriere. This soil is characterised by a high content of stones and coarse sand

and by a marked vertical variability. It is extremely porous, loose and open and contains little or no colloidal matter except humus. The organic matter of the Grand Sable soil (Profile 31 (1)) is about 1½% but falls off rapidly with depth and the C/N ratio is high indicating that much of the organic matter present had not been converted into humus. The available phosphate and potash are fairly high but the rate of solution is low. This soil is somewhat acidic having a pH of 6·5 in the surface and slightly higher in the lower layers.

At *Union* the soil was a somewhat eroded and leached *Low Level Yellow Earth* type (1) that had been under groundnuts for several years and had accordingly suffered. Soils of this type are characterised by a high vertical uniformity down to six feet at least and are designated as "hill-creep" soils. The colour is dark sepia-brown becoming more yellow below, the organic matter content is low, about 1%, but does not vary much down to about three feet or more, and the C/N ratio is high, between 6·5 and 8. The texture is uniformly sandy (the index of texture is about 14) with numerous small soft crumbling stones. The available phosphate is low, available potash medium and the rate of solution is low. The reaction is slightly acidic, pH 6·5.

In both experiments ratoon arrowroot fields were used as there was greater uniformity in stand than in plant fields. There was a fair abundance of cigar rhizomes at Union. The experimental areas were treated as normal estate fields throughout the experiment.

Manuring and Reaping.

The previous crops had been dug on 11. 5. 35 at Grand Sable and on 17. 5. 35 at Union and the manures were applied on 20. 8. 35 at Grand Sable and on 30. 8. 35 at Union. The experimental plots were reaped on 20. 4. 36 and 14. 4. 36 at Grand Sable and Union respectively.

Treatments.

The dressings of the three manures used were :—

1. Sulphate of Ammonia
   - no application (n_0)
   - unit ,, (n_1) = 150 lb. per acre.
   - double ,, (n_2) = 300 ,, ,, ,,

2. Superphosphate
   - no application (p_0)
   - single ,, (p_1) = 168 lb. per acre.
   - double ,, (p_2) = 336 ,, ,, ,,

3. Sulphate of Potash
   - no application (k_0)
   - single ,, (k_1) = 90 lb. per acre
   - double ,, (k_2) = 180 ,, ,, ,,

Plot lay-out and Yields.

Each experiment consisted of three randomised blocks of nine plots each. The treatments within the blocks were so arranged as to conserve all main effects and first order interactions but two of the eight degrees of freedom due to second order interactions were confounded with block differences, as mentioned above. Each plot was 50 x 17 feet or approximately 1/51 acre with a three feet border. The length of the blocks was placed at right angles to the slope at Union where the experiment was laid down on a hillside, and at Grand Sable where the site chosen was flat, at right angles to what was thought to be the fertility gradient. The plots which were rectangular extended the full width of the block down the slope or fertility gradient.

The lay-out of the plots and the yields of rhizomes in lb. per plot are given in Table XXV for both experiments and the analysis of variance for the combined experiments is given in Table XXVI. There were some differences in the manurial response at the two centres which will be detailed later.

TABLE XXV.

Grand Sable.

$n_0p_0k_0$	$n_0p_1k_1$	$n_1p_2k_0$	$n_2p_1k_0$	$n_1p_0k_1$	$n_0p_2k_2$	$n_2p_2k_1$	$n_2p_0k_2$	$n_1p_1k_2$
179	242	319	421	402	370	407	401	364
$n_2p_0k_0$	$n_1p_1k_0$	$n_2p_1k_1$	$n_0p_1k_2$	$n_1p_2k_1$	$n_2p_2k_2$	$n_0p_0k_1$	$n_0p_2k_0$	$n_1p_0k_2$
392	368	376	237	363	387	272	319	422
$n_1p_1k_1$	$n_0p_1k_0$	$n_0p_0k_2$	$n_2p_1k_2$	$n_1p_0k_0$	$n_1p_2k_2$	$n_0p_2k_1$	$n_2p_2k_0$	$n_2p_0k_1$
414	269	292	522	398	384	272	446	471

Union.

$n_0p_0k_2$	$n_0p_1k_0$	$n_2p_2k_2$	$n_1p_1k_2$	$n_2p_1k_1$	$n_0p_2k_1$	$n_2p_0k_0$	$n_1p_0k_1$	$n_1p_2k_0$
189	165	184	193	278	241	233	248	206
$n_2p_1k_0$	$n_1p_1k_1$	$n_0p_2k_0$	$n_0p_0k_1$	$n_2p_0k_2$	$n_0p_1k_2$	$n_1p_0k_0$	$n_2p_2k_1$	$n_1p_2k_2$
294	208	121	135	261	124	180	261	170
$n_2p_0k_1$	$n_2p_2k_0$	$n_0p_0k_0$	$n_0p_1k_1$	$n_1p_0k_2$	$n_1p_2k_1$	$n_0p_2k_2$	$n_2p_1k_2$	$n_1p_1k_0$
277	230	117	205	265	220	144	279	170

TABLE XXVI.

Due to	Degrees of Freedom.	Sum of Squares.	Mean Square.	½ log e (Mean Square).	Z.
Blocks	5	325,538·59			
N_1	1	136,900·00	136900·00	2·45966	2·22811
N_2	1	2,987·26	2987·26	0·54718	0·31563
P_1	1	261·36	261·36		
P_2	1	49·34	49·34		
K_1	1	3,761·78	3761·78	0·66250	0·43095
K_2	1	2,924·48	2924·48	0·53655	0·30500
NxP	4	18,205·41	4551·35	0·75771	0·52616
NxK	4	1,886·18	471·54		
PxK	4	6,758·07	1689·52		
Error	30	47,664·57	1588·82	0·23155	
Total	53	546,937·04			

For P=·05, n_1=1, n_2=30, Z=0·7141
For P=·05, n_1=4, n_2=30, Z=0·4947.

The mean square for error is rather high in the above table and the standard error is 14·05% of the mean. This is in some measure due to the differential response of certain of the treatments at the two centres thereby increasing the error sum of squares.

The analysis shows that treatment has had a highly significant effect on yield. Also a very large fraction of the treatment sum of squares is due to nitrogen and while phosphate has not exerted a direct effect of any magnitude there has been a significant interaction between phosphate and nitrogen. These effects will now be examined in detail.

Main Effects.

Nitrogen. The effect of nitrogen is measured by the two contrasts denoted N_1, and N_2 which are statistically independent comparisons (2). The three levels of nitrogen are denoted by n_0, n_1 and n_2 as stated above and N_1, which is known as the principal effect is defined as follows.

$$N_1 = n_2 - n_0.$$

N_2 which measures the effect of the second unit of nitrogen as compared with the first, is defined as follows.

$$N_2 = 2n_1 - n_0 - n_2.$$

In a similar manner the effects of phosphate and potash have been analysed each into two statistically independent comparisons.

The maurial effects of n_0, n_1 and n_2 are shown in Table XXVII (yields are given in totals of six plots, three from each centre).

TABLE XXVII.

	p_0	p_1	p_2	Total.
n_0 -	1,191	1,242	1,467	3,900
n_1 -	1,915	1,717	1,662	5,294
n_2 -	2,035	2,170	1,915	6,120
Total -	5,141	5,129	5,044	15,314

From this table N_1 =2,220 lb. while N_2=568 lb. for totals of eighteen and thirty-six plots respectively.

The table of the analysis of variance shows that N_1 is most decidedly significant while the increase due to the second unit of nitrogen in the larger dressing of sulphate of ammonia does not differ significantly from that due to the first unit. This result is surprising and indicates in a striking manner the pronounced nitrogen deficiency of certain St. Vincent soils with regard to the arrowroot crop. It is usual to obtain a smaller increase in yield from the additional dressing of a fertilizer in accordance with the Law of Diminishing Returns. Table XXVII does show a diminishing effect but it is not significant and if the results from the two centres are considered separately it can be shown that at Union the increment due to the second unit of nitrogen was very slightly larger than that due to the first unit whereas at Grand Sable the additional increase was considerably smaller. It would appear, therefore, that under the conditions of the experiment at Union a dressing of 300 lb. per acre of sulphate of ammonia was not sufficient to supply the nitrogen requirements of the crop whereas at Grand Sable larger dressings would probably not have been profitable.

The average increase in yield due to an application of 300 lb. of sulphate of ammonia was 56·9 %, a very large increase indeed. At Grand Sable the increase was 54·5 % and at Union 59·4 %.

Phosphate. It was calculated from Table XXVII that $P_1 = -97$ lb. for a total of 18 plots, and P_2=73 lb. for a total of 36 plots. Both these values are very small and are not statistically significant. It is concluded, therefore, that phosphate does not by itself effect any material change in the yield of rhizomes.

Potash. The main effects of potash may be calculated from the K totals of Table XXVIII.

TABLE XXVIII.

	k_0	k_1	k_2	Total.
n_0 -	1,170	1,367	1,363	3,900
n_1 -	1,641	1,855	1,798	5,294
n_2 -	2,016	2,070	2,034	6,120
Total -	4,827	5,292	5,195	15,314

The values obtained are k_1=368 and k_2=562, neither of which, however, is statistically significant according to Table XXVI. This lack of statistical significance is due chiefly to the different response to this fertilizer at the two centres. The individual results for the two experiments are given in Table XXIX.

TABLE XXIX.

	k_0	k_1	k_2
Grand Sable -	3,111	3,219	3,386
Union -	1,716	2,073	1,809
Total -	4,827	5,292	5,195

At Union the principal effect k_1 was small and not significant but k_2 was much larger and definitely significant. That is, there was a significant difference between the responses to the first and second units of potash—this is clearly shown by the large value for k_1 and the much smaller value for k_2.

At Grand Sable the response to potash increased regularly with the size of the potash dressing and consequently k_2 is quite small and not significant. The principal effect k_1 on the other hand is greater and apparently the requirement for potash was not satisfied in this experiment by even the larger dressing.

When these two results are combined together it is obvious that the average values for k_1 and k_2 would be considerably reduced and, in fact, with the rather high standard error of the combined experiments neither is significant statistically.

The increase in yield due to a unit dressing of potash at Union was 20·8 % while that due to a double dressing at Grand Sable was 8·8 %.

Interactions.

Nitrogen and Phosphate. From Table XXVI it can be seen that there is a statistically significant interaction between nitrogen and phosphate (N x P).

The interaction between any two of the fertilizers may be analysed into four independent comparisons which are expressed in terms of the two independent comparisons already mentioned. Thus the interaction between the principal effects of nitrogen and phosphate may be written N_1 P_1. In the case af the nitrogen and phosphate, calculations of these contrasts from Table XXVII yield the following values :

N_1 P_1 = —396, N_2 P_2 = —502, N_2 P_1 = —602 and N_1 P_2 =564.

In general, therefore, the interaction between nitrogen and phosphate is negative, i.e., the response to nitrogen was lower in the presence of phosphate than in its absence and *vice versa*. There is, however, a sharp break in the relationship as shown by the positive value of 564 obtained for N_1 P_2. This indicates a marked difference between the interaction of the principal effect of nitrogen with the unit and with the additional dressing of phosphate. This effect is clearly shown in Table XXVI in which the highest value is due to the treatment n_2 p_1. This effect was precisely similar at both Grand Sable and Union.

Nitrogen and Potash. The analysis of variance shows that the interaction between nitrogen and potash is very small and statistically not significant. A scrutiny of Table XXVIII shows that the response to nitrogen bears little relationship to varying quantities of potash and *vice versa*. There was no appreciable difference between the relationship at Grand Sable and that at Union.

Potash and Phosphate. The analysis of variance of the combined experiments indicates that the interaction between potash and phosphate is not statistically significant. Once again, however, the manurial effects were not the same at the two centres and this has considerably reduced the total effect when the two are combined.

It can be shown that the interaction between potash and phosphate at Union is statistically significant but not so at Grand Sable.

The yield figures for the potash phosphate effects at Union are given in Table XXX.

TABLE XXX.

		p_0	p_1	p_2	Total.
k_0	-	530	629	557	1,716
k_1	-	660	691	722	2,073
k_2	-	715	596	498	1,809
Total	-	1,905	1,916	1,777	5,598

The calculated values for the four independent comparisons are $K_1P_1 = -244$, $K_2P_2 = -150$, $K_1P_2 = -192$ and $K_2P_1 = 314$.

The general trend of the interaction is negative so that the response to potash is less in the presence of phosphate and *vice versa*. The value for K_2P_1 however, is positive and statistically significant and indicates that increasing the quantity of potash relative to phosphate markedly reduces the response. The highest yields were obtained either from a unit dressing of potash combined with a double dressing of phospate or from the double dressing of potash above.

At Grand Sable the response to potash was much less and the interaction was not statistically significant. The general trend, however, is negative with no positive value as at Union.

Conclusion.

The results of the above experiments confirm those of previous experiments and indicate that St. Vincent soils suffer from a marked deficiency of nitrogen in so far as the arrowroot crop is concerned.

The average increase of 57% in yield of rhizomes was obtained over a wide range of conditions as explained when dealing with the design of the experiments. This variety of conditions is probably greater than would ordinarily be encountered with regard to phosphate and potash variation in the soil so that the conclusion that a dressing of 300 lb. of sulphate of ammonia produces an increase of the order of 50%—60% rests on a fairly substantial foundation.

The financial gain resulting from an increase in yield of 57% has been calculated to be about $45.00 per acre (See Annual Report for 1934), after all expenses have been deducted, assuming that nitrogenous manuring has no effect on the starch content of the rhizomes—the evidence available appears to show that sulphate of ammonia does not decrease the starch yield and may actually increase it quite appreciably under certain conditions.

The relationship between potash and yield of rhizomes appears to be more complicated. At Grand Sable the response to potash was small and not significant but the response was apparently linear and increased with the size of the dressing of potash. At Union, on the other hand, the response was much greater

and significant but decreased with the larger dressing. The reason for this difference is not clear but it may possibly be due to;

(*a*) soil differences, or
(*b*) a different response of "cigar" plants to potash.

According to the analysis of typical soils the average phosphate content of "Yellow Earth, Low Level" soils is low (22 parts per million) and potash is not high (166 parts per million), whereas in the "Recent Volcanic Ash" soils the phosphate is higher (82 parts per million) and potash not high (131 parts per million). It is not possible at the present stage, however, to explain the difference, and more data will be required so that the various factors may be separated.

The interactions between nitrogen and phosphate and potash are highly interesting but very complicated and again more data are required before any satisfactory conclusions may be drawn.

Until further information is available, therefore, it is recommended that sulphate of ammonia should be the only artificial fertilizer applied to arrowroot, and that the application should be made at the rate of 300 lb. per acre.

Cotton Manurial Experiments.

Two cotton manurial experiments were laid down by the Department during the season 1935-36, one at Diamond Estate and the other at Kearton's Estate.

The experiment laid down in 1934-35 was described in the Annual Report for 1934 and indicated that applications of nitrogen produced very large increases in yield. The increase obtained from a dressing of 3 cwt. of sulphate of ammonia per acre was considerable, the yields from control plots and sulphate of ammonia plots being 1,257 lb. and 2,000 lb. of seed cotton per acre respectively. A complete dressing of artificials gave even slightly larger returns.

In laying down the 1935-36 experiments, two courses might have been adopted. The experiments might have been devised to investigate the effect of different combinations of nitrogen, potash and phosphate. Alternatively, advantage might have been taken of the fact that sulphate of ammonia produced large increases in yield, and the experiments designed to obtain further information concerning the effect of this manure alone. The latter course was chosen as it was thought that it would provide planters more or less immediately with information which would enable them to obtain substantial increases in yield at a low cost, and of which use could be made during the time in which more exhaustive experiments were carried out. The experiments were designed to provide information concerning the quantity of sulphate of ammonia which should be applied and at what time the application should be made.

A description of the two experiments is given below.

Diamond Estate.

The site chosen was in the centre of an alluvial flat. The soil was of medium texture, and probably as uniform as could be obtained in St. Vincent. The previous crop was cassava.

The lay-out of the experiment was a 6 x 6 latin square, the individual plots being 30 x 36 feet or approximately 1/40 acre. Each plot consisted of nine banks, 10 yards long, in each of which were made twenty planting holes, 18 inches apart. Every tenth bank and every twenty-first planting hole along the banks were used as guard rows to separate the plots.

The grass and weeds were cleared from the future sites of the furrows, and ranged in the sites of the banks. The cleared portions were then ploughed, on August 22nd, and the loose soil pulled over the grass to form the banks. The whole field was ridged with banks 4 feet apart running north and south.

The field was planted on August 26th and supplied on September 6th and 16th. The germination was excellent and two plants were established and left

in nearly every hole. The after cultivation consisted of weeding and remoulding the banks according to the usual estate practice.

Kearton's Estate.

The site of this experiment was in a small valley on the leeward coast on fairly low lying land, sloping gradually from east to west. The soil was light, porous, fairly low in fertility and varied slightly owing to local deposition of sandy sediment as the result of washing during heavy rains.

The lay-out of the experiment was a 6 x 6 latin square, each plot being 52 x 21 feet or approximately $\frac{1}{40}$ acre, and consisting of 13 banks, 4 feet apart running from north to south, each containing 14 planting holes 18 inches apart. Every fourteenth bank and every fifteenth hole in each bank were used as guard rows.

The field was weeded and lined and the ridges were formed with hoes on September 4th and 5th. Planting was carried out on September 5th and 6th. The germination was excellent but owing to damage by mole crickets, the fields had to be supplied twice. An attempt was made to establish two plants in each hole. The after cultivation consisted of weeding and remoulding the banks when necessary as usually carried out by the estate.

In both the Diamond and Kearton's experiments, the same six manurial treatments were given as follows.

(*a*)	Control. No manure.						
(*b*)	Sulphate of ammonia	150 lb.	per	acre	applied		early
(*c*)	,,	,,	150 lb.	,,	,,	,,	late
(*d*)	,,	,,	300 lb.	,,	,,	,,	early
(*e*)	,,	,,	300 lb.	,,	,,	,,	late
(*f*)	,,	,,	150 lb.	,,	,,	,,	early
		plus	150 lb.	,,	,,	,,	late.

In the Diamond experiment, the early and late applications of manure were made on September 24th and October 12th, respectively. In the Kearton's experiment the early applications were made on October 3rd and the late on October 21st. The early dressings were therefore applied approximately 4 weeks after planting, and the late dressings approximately six weeks after planting.

In both experiments the effect of the different treatments on growth was very similar. The amount of foliage and the vigour and size of the plants produced in each plot were more or less directly proportional to the quantity of sulphate of ammonia which the plot had received. Thus the plants which received sulphate of ammonia at the rate of 300 lb. per acre were frequently over six feet high, those which received it at the rate of 150 lb. per acre were about five feet high, whereas plants in the control plots were usually less than four feet high. Within each plot the height of the plants was fairly uniform.

The plots were picked once per week from December 24th to March 23rd at Diamond, and from January 15th to March 31st at Kearton's.

Each picking from each plot was dried and weighed separately, and the pickings from each plot were then bulked and weighed when they were thoroughly dry at the end of the season.

During the first three pickings, most seed cotton was obtained from the control plots, and the plots receiving 300 lb. sulphate of ammonia yielded least. At the fourth picking, the plots receiving 150 lb. yielded most while at Diamond the control plots, and at Keartons the plots receiving 300 lb., yielded least. From the fifth to the last pickings the plots receiving 300 lb. yielded most and the control plots least.

The variations in the time of maturity of plants receiving the different treatments can easily be explained. The plants in the control plots produced

few flowers but almost all the flowers, even the first to be formed, developed bolls which were subsequently picked. The plants which received sulphate of ammonia produced a greater amount of foliage, and almost all the first bolls were lost owing either to shedding or boll-rotting. The loss of these first bolls, however, was unimportant as the plants continued to grow vigorously for a longer period, and eventually produced many more bolls than the control plants.

The plan of the experiments, the treatments and the yields of seed cotton obtained in quarter pounds per plot are shown in Table XXXI.

TABLE XXXI.

Diamond.						*Keartons.*					
E	D	F	C	A	B	D	F	B	A	E	C
184	166	202	172	134	172	199	193	156	138	160	138
A	B	C	E	D	F	A	E	F	C	B	D
134	168	180	200	198	210	138	166	166	140	134	152
D	E	A	B	F	C	C	B	E	D	F	A
208	196	152	180	220	192	158	152	146	126	146	120
F	C	B	D	E	A	F	D	C	B	A	E
196	186	192	216	218	152	176	156	140	124	124	164
C	F	E	A	B	D	B	A	D	E	C	F
158	202	180	142	172	206	146	122	162	166	158	172
B	A	D	F	C	E	E	C	A	F	D	B
154	124	176	188	190	220	144	134	127	154	152	164

The yields in quarter pounds per treatment are given in Table XXXII. In the last three columns the yields are expressed in pounds of lint per acre by assuming that 100 lb. of seed cotton are equivalent to 25 lb. lint.

TABLE XXXII.

Treatment.	Yield in ¼ lb. per treatment.			Yield in lint per acre.		
	Diamond.	Keartons.	Total.	Diamond.	Keartons.	Average.
A ...	838	769	1,607	349	320	335
B ...	1,038	876	1,914	432	365	399
C ...	1,078	868	1,946	449	362	405
D ...	1,170	947	2,117	487	395	441
E ...	1,198	946	2,144	499	395	447
F ...	1,218	1,007	2,225	507	419	464
Total ...	6,540	5,413	11,953			

As the effects of different treatments in both experiments were very similar results of the two experiments were combined, and subjected to statistical analysis. The analysis of variance is given in Table XXXIII.

TABLE XXXIII.

Due to	Degrees of Freedom.	Sum of Squares.	Variance.	½ log e Variance.	Z.
Rows ...	10	4,253			
Columns ...	10	3,149			
Squares ...	1	17,640	17,640	4·8895	2.4320
Treatment ...	5	20,787	4,157·4	4·1665	1.7090
Interaction ...	5	1,765	353	2·932	.4745
Error ...	40	5,449	136·2	2.4575	
Total ...	71	53,043			

From Fisher's Tables the following values of Z were obtained.

1. Squares : $N_1 = 1$, $N_2 = 40$, and $P = \cdot 01$ $Z = 1\cdot 0005$
2. Treatments : $N_1 = 5$, $N_2 = 40$, and $P = \cdot 01$ $Z = \cdot 6370$ (approx.)
3. Interaction : $N_1 = 5$, $N_2 = 40$, and $P = \cdot 05$ $Z = \cdot 4536$ (approx.)

It has been calculated that a difference between any two treatment totals greater than 115·4 quarter pounds is significant. The treatment totals are given in the fourth column of Table XXXII. The conclusions to be drawn from the experiments are therefore that :

(1) Treatments involving the application of either 150 lb. or 300 lb., of sulphate of ammonia produced significantly better yields than the controls.

(2) The application of 300 lb. of sulphate of ammonia produced significantly better yields than the application of 150 lb.

(3) The differences in yield due to the application of manures at the different times were not significant.

Both experiments therefore confirm the indications obtained last year that nitrogen is the limiting factor in the production of seed cotton. They also indicate that the quantity of nitrogen usually applied by growers could be considerably increased with very profitable results. At present large areas of cotton are grown without any application of manure, and where sulphate of ammonia is used it is usually applied at the rate of 100–150 lb. per acre. No instance is known where an application has exceeded 2 cwt. per acre. In the last column of Table XXXII it will be seen that the minimum average increase in yield per acre accruing from the application of 300 lb. sulphate of ammonia was equivalent to more than 100 lb. of lint, plus 300 lb seed. The value of 100 lb. lint at present prices is about 150 shillings. The cost of purchasing and applying 300 lb. of sulphate of ammonia is less than thirty shillings. The cost of picking, sorting and carting the extra 400 lb. of seed cotton would cost much less than 20 shillings. The value of the extra 300 lb. seed obtained would more than pay for the extra cost of ginning and baling. Under these conditions, therefore, an increase in yield of 100 lb. of lint per acre produces an additional profit of more than £5 per acre.

Although differences in yield due to different times of application were not significant, the experiments have provided a valuable indication of when sulphate of ammonia would be best applied. It is very unlikely that plants less than three and a half or four weeks old would be sufficiently developed to make full use of a large dressing of sulphate of ammonia, and as the growing period of cotton is relatively short, it is also unlikely that dressings should be given after 6 weeks. It therefore seems probable that the best time to apply sulphate of ammonia would be between four and six weeks after the date of planting. Again, in spite of the yield resulting from a double application of 150 lb. being not significantly greater than that resulting from a single application of 300 lb. there are indications that the double dressing was advantageous, especially under the conditions existing at Kearton's, where the soil was very light and sandy.

The seed cotton obtained from each plot in these experiments was sorted and ginned separately and the yields of white lint were again subjected to statistical analysis. The results of this analysis enabled the same main conclusions to be drawn, namely that applications of 300 lb. sulphate of ammonia produced significantly higher yields than 150 lb., and applications of 150 lb. produced significantly higher yields than the controls.

According to the figures obtained, the ginning percentages varied slightly, and were higher in the case of the experiment at Diamond as shown in Table XXXIV. It is probable that the cotton plants growing in the light sandy soil at Keartons were more effected by the severe drought which undoubtedly shortened the picking season throughout the island.

TABLE XXXIV.

Treatment.	Ginning percentage.	
	Diamond.	Keartons.
A	24·9	24·0
B	25·6	23·9
C	25·3	24·3
D	25·8	24·0
E	25·4	24·4
F	25·6	24·0
Average	25·4	24·1

Agricultural Education.

The Agricultural Superintendent examined the First, Second and Third Year Pupil Teachers in Agriculture in September 1935.

The Cotton Inspector gave a number of lectures and practical demonstrations to boys at the Grammar School, and continued to give advice to peasants on agricultural matters. A large number of peasants were induced to apply sulphate of ammonia to their crops.

Official Visitors 1935.

The following visitors paid visits to the Agricultural Department during the year : —

Mr. C. C. Skeete, Assistant Commissioner of Agriculture, from January 19th to 25th to discuss and advise on various agricultural matters.

Mr. H. L. Manning, Agricultural Assistant, Montserrat, from January 11th to February 8th to study cotton breeding methods at the Cotton Research Station. Mr. Manning spent several days with officers of the Agricultural Department discussing agricultural problems and was taken on several visits to estates.

Mr. G. A. Jones, Commissioner of Agriculture, from May 8th to 15th to inspect the work of the Department and to discuss and give advice on various agricultural matters.

Mr. C. R. Stollmeyer, Trade Commissioner in Canada for the West Indies (Eastern Group) to discuss matters concerning trade with Canada.

Other visitors included Sir Geoffrey Evans, Principal, Imperial College of Tropical Agriculture, Mr. E. J. Wortley, Director of Agriculture, Trinidad ; Mr. Munro-Kerr, of Messrs J. & P. Coats Ltd., Dr. O. W. Barrett, Botanist, Mr. Scott, Sugar Technologist, and Dr. Dunlop and Messrs. Alexander and Price of the Canadian Banana Company.

SECTION III.

Financial Statement.

The sum of £2,428 was voted for the maintenance of the Agricultural Department during the year 1935.

The appointment of Mr. George Fraser, Instructor for the Banana Industry, terminated on July 15th, 1936 but was extended on condition that the Banana Association would re-imburse Government for his salary and travelling allowance. Two Field Assistants for the Banana Industry were appointed on November 1st, under the same conditions.

By means of a loan obtained from the Colonial Development Fund Mr. C. C. Seale was appointed Crop Specialist (Sugar) on October 17th 1935 to carry out investigations to improve and standardise the quality of syrup manufactured in St. Vincent.

Mr. C. George and Mr. S. B. Isaacs, formerly Clerk to the Government Fruit and Vegetable Bureau, were appointed Cadets in the Department on February 18th and June 1st, respectively.

The details of expenditure are given below :—

	£	s.	d.
Salary, travelling allowance, Agricultural Superintendent ...	572	5	3
Salary, travelling and house allowances, Agricultural Assistant	238	15	2
Salary and travelling allowance, Instructor for Banana Industry	223	8	4
Salaries, Foreman, Botanic and Experiment Stations, Cotton Inspector and Government Vaccinating Officer, Clerical and Laboratory Assistants and Cadets, and travelling allowances, Cotton Research Officer, and Cotton Inspector and Government Vaccinating Officer	503	19	2
Upkeep, Botanic and Experiment stations, (labour, manures, tools, seeds &c.)	548	17	4
Destruction of food plants of the Cotton Stainer ...	7	4	5
Destruction of diseased Banana Plants	7	8	1
Scientific apparatus for Syrup Investigations	50	8	4
Special Cotton Investigations	38	1	6
Visit of Dr. Myers to St. Vincent	11	15	4
Contribution to Imperial College of Tropical Agriculture ...	328	0	0
Contribution to various Scientific Institutions &c. ...	44	0	0
From Colonial Development Fund :—			
Salary, Travelling and house allowances Crop Specialist (Sugar)	77	12	0
Miscellaneous expenditures for Syrup Investigations ...	5	19	0
Total	2,657	13	11

The receipts for the sale of plants and produce at the Experiment and Botanic Stations amounted to £73 11. 8.

SECTION IV.

Summary of Agricultural Legislation 1935.

Ordinances.

No. 6 of 1935. To regulate the quantity, quality and price of locally manufactured unrefined sugar to be sold in the Colony.

No. 11 of 1935. To amend the Cotton Export Levy Ordinance 1934.

No. 12 of 1935. To amend the Banana Ordinance 1934.

No. 14 of 1935. Plant Protection Ordinance. This Ordinance gives the Agricultural Department greater powers to prevent the introduction of pests and diseases, and also enables it to enforce control measures in the case of certain pests and diseases which have already become established in the Colony. The Importation of Plants Diseases Prevention Ordinance (Cap. 36) and all amendments thereto were repealed.

No. 20 of 1935. To carry out certain conventions relating to the employment of women, young persons and children.

No. 24 of 1935. To provide for the establishment of a Board of Agriculture.

No. 26 of 1935. To amend the Labour (Minimum Wage) Ordinance 1934.

No. 31 of 1935. To amend the Land and House Tax Ordinance (Cap. 194).

No. 40 of 1935. To regulate the procedure in the propagation and subsequent treatment of special cotton seed for planting, and to enable the Agricultural Department to select and obtain additional seed from any grower should it be needed. The Cotton Seed Control Ordinance 1933 was repealed.

No. 44 of 1935. To authorise the Governor in Council to raise a loan of £4,100 for the purpose of converting part of the loan raised under the Land Settlement Ordinance 1932. By raising this loan it was possible to extend the period of payment for land purchased under the Three Rivers Land Settlement Scheme from 10 to 20 years.

Orders-in-Council.

11th May and August 2nd. Under the Cotton Protection Ordinance Cap. 37. Declaring close season for cotton and ochros as follows :—

St. Vincent and Mustique from 1st June to 15th August.

St. Vincent Grenadines (except Mustique) from 15th May to 31st August.

1st August. Under the Plant Protection Ordinance, No. 14 of 1935. Declaring certain districts to be "Panama Disease Infected Areas."

9th August. Under the Sugar (Local Consumption) Ordinance No. 6 of 1935. Regulating the wholesale and retail prices of unrefined sugar for local consumption.

Rules, Regulations, &c.

22nd February, 5th April, 4th June and 7th October. Under the Agricultural Credit Societies Ordinance, No. 1 of 1934. Regulations for the control and management of the Three Rivers Agricultural Credit Society and the Arrowroot Works and Syrup Works leased by the Society.

23rd March. Under the Importation of Animals (Diseases Prevention) Ordinance No. 2 of 1933. Fixing tariff of fees for the inspection of animals imported into the Colony.

Proclamations.

1st August. Under the Plant Protection Ordinance No. 14 of 1935. Prohibiting the importation of certain plants, plant material and soil into the Colony except under conditions specified. Also proclaiming certain pests and diseases to be "proclaimed pests" and "proclaimed diseases."

APPENDIX I.

Meteorological Observations.

The rainfall recorded at various centres in St. Vincent during the year 1935 and the average rainfall at the Botanic Gardens for the last 42 years are given in Table XXXV.

TABLE XXXV.

Stations.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Botanic Gardens ...	3·85	4·44	2·92	2·51	12·59	5·03	13·95	11·03	13·13	13·86	8·15	5·89	97·35
Chateaubelair ...	2·64	2·65	1·85	2·51	8·38	6·08	8·20	19·12	15·65	14·68	6·00	6·09	93·85
Experiment Station ...	3·25	4·56	2·57	1·68	12·99	4·52	12·81	10·28	11·26	14·11	8·02	6·67	92·72
Colonarie ...	4·06	2·63	1·63	2·42	14·67	3·24	12·52	12·79	11·12	9·45	6·41	5·00	85·94
Sans Souci ...	5·18	2·60	·90	3·10	14·33	2·27	9·92	7·59	10·94	11·44	5·39	5·26	78·92
Troumaca ...	2·36	1·42	1·40	1·32	7·47	3·18	14·83	10·94	10·91	9·03	7·06	6·04	75·96
Bequia ...	1·99	2·70	1·71	2·38	10·18	6·05	11·07	13·18	8·89	3·67	6·35	6·42	74·59
Barrouallie ...	2·09	1·71	1·69	1·18	7·69	2·16	13·97	10·40	9·34	13·65	3·66	3·76	71·30
Brighton ...	1·90	1·07	1·21	1·44	11·39	2·88	8·91	5·26	6·42	6·72	5·85	4·60	57·65
Union Island ...	1·60	2·20	1·30	·50	5·50	3·30	11·03	4·39	8·01	4·15	2·55	4·00	48·53
Canouan ...	2·42	1·45	·64	·38	4·34	·89	4·78	4·98	6·94	5·17	3·82	7·26	43·07
Mayreau ...	·59	·54	·84	·24	2·43	·38	4·21	3·41	5·61	4·05	2·00	4·28	28·58
Botanic Gardens, average rainfall, 42 years	6·36	4·20	4·02	4·00	6·71	10·88	11·76	11·77	11·16	11·98	11·48	7·92	102·27

Rain was recorded on 277 days at the Botanic Station during the year, and on 269 days at the Experiment Station.

The following Table gives the mean temperature, degree of humidity and barometric pressure at the Experiment Station for each month of the year.

Meteorological Observations, Experiment Station 1935.

TABLE XXXVI.

Months.	Mean temperature F°.	Average degree of humidity Saturation 100.	Mean Barometric pressure in inches.
January ...	80·4	75·4	29·966
February ...	80·3	78·4	30·016
March ...	80·5	68·5	29·995
April ...	81·9	77·8	29·956
May ...	81·3	76·2	29·956
June ...	82·3	74·3	29·974
July ...	82·1	77·5	29·968
August ...	83·1	73·7	29·918
September ...	83·2	73·4	29·949
October ...	81·8	74·9	29·986
November ...	82·7	73·9	29·880
December ...	80·7	72·5	29·946

Atmospheric Pressure.

The reading of the barometer, corrected for instrumental error, elevation, temperature and latitude ranged from 30·102 on March 13th to 29·802 on 8th October.

APPENDIX II.

Government Fruit and Vegetable Bureau.

The examination of records of the transactions of the Government Fruit and Vegetable Bureau in previous Annual Reports shows that the year 1934 was the only year in which a profit was made. Even the profit in 1934 amounting to £29. 5. 11 was arrived at without taking overhead expenses into consideration.

It was apparent from the records that the shipment of only two kinds of fruit was likely to be remunerative, namely, tomatoes and limes. The heaviest yields of tomatoes are obtained in St. Vincent during December, January and February. Owing to severe competition in the Canadian market for tomatoes during these months, however, it was impossible to consider making shipments before March. At the end of May prices again declined. The market for limes in Canada commences with the appearance of hot weather and declines when the weather becomes cooler. It is therefore possible to obtain satisfactory prices only during the months of June and July, and perhaps in August.

In 1935, 448 crates of tomatoes were purchased from peasants on a co-operative basis by giving an advance of one cent per lb. as in previous years, and by distributing a bonus when all the account sales had been received. The bonus paid was ½ cent per lb. making a total payment of 1½ cents per lb.

Limes were bought outright from the peasants during June and July for one cent per lb. and shipped as Government produce. Although lime trees in St. Vincent do not come into full bearing until September, no limes were shipped later than 31st July. By restricting shipments in this way quite good profits were realised. The total shipments of limes amounted to 606 crates.

In consequence of the small amounnt of business which the Bureau could undertake to expect remunerative returns, the Bureau was closed down at the end of July, 1935.

The accounts for the year ending December, 31st 1935 are given in Tables XXXVII and XXXVIII.

TABLE XXXVII.

STATEMENT OF EXPENDITURE AND RECEIPTS, AS AT 31ST DECEMBER, 1935.

	£ s. d.	£ s. d.
To Balance due Treasury as at 1. 1. 35 ...	89 2 11	
Labour	8 4 7	
Purchase of fruit	64 6 10	
Freight and Lighterage	28 2 5	
Porterage	2 9 0	
Bus hire	3 9 11	
Lodge rent	1 3 11	
Refrigeration	2 6 0	
Purchase of W. I. Labels (St. Lucia) ...	3 14 0	
Inspection fee	1 0 4	
Purchase of Wrapping paper (abroad) ...	3 0 3	
„ „ „ „ (locally) ...	1 16 8	
Making of crates	14 2	
Nails	13 3	
Sundries	2 8	
Contribution to Revenue	33 8 0	
By Receipts from abroad		243 2 7
„ (locally)		9 2
Unpaid Vouchers		3 2
	£ 243 14 11	243 14 11

TABLE XXXVIII.

STATEMENT OF LIABILITIES AND ASSETS AS AT 31ST DECEMBER, 1935.

Liabilities.	£	s.	d.	*Assets.*	£	s.	d.
Unpaid claims ...		3	2	Value of Stock ...	54	11	8
Unclaimed Bonus 1933 ...		15	5	Amount due abroad (approximately) ...	13	2	10
„ „ 1934 ...		17	9				
Tomato Bonus due 1935 ...	11	14	4	Amount due locally (approximately) ...		10	11½
Excess Assets ...	54	14	9½				
	£68	5	5½		£68	5	5½

APPENDIX III.

Three Rivers Land Settlement.

The sale of allotments on the Three Rivers Land Settlement commenced in May, 1933. There were 132 allotments amounting to 631 acres available for distribution and 39 acres 33 poles were demarcated as reserves. The regulations in force at that time required that 20 per cent of the purchase money should be deposited by applicants before their applications would be considered. The remainder of the purchase money was to be paid in ten annual instalments. In April, 1934, 338 acres had been taken up, but sales were very slow during the next few months. At the end of August 1934, Government reduced the deposit required from 20 per cent to 10 per cent to encourage possible applicants to purchase land more readily. This action had an immediate effect and at the end of the year only 17 allotments comprising 99 acres 1 rood 29 poles remained to be distributed.

In 1935, by the conversion of part of the 10-year loan obtained for purchasing the land into a 20-year loan bearing a smaller rate of interest, Government was enabled to extend the period of payments for land to twenty years, and to make a reduction in the amount of the annual instalments. This action has been of considerable assistance to the allottees. Ten allotments comprising 50 acres 1 rood 5 poles were taken up during 1935, and at the end of the year 125 allotments or 563 acres 3 roods 16 poles had been taken up. Only 7 allotments (49 acres 24 poles) therefore remained to be distributed.

Most of the allottees take a great interest in their allotments, and the appearance of their cultivations is very satisfactory. The arrears in the payment of annual instalments and interest for the year 1935 amounted to £595. 5. 0 at 31st December.

APPENDIX IV.

Agricultural Credit Societies.

There are still five Agricultural Credit Societies in existence but owing to the difficulty of obtaining loans, four of the Societies show very little activity.

Clare Valley—Questelles. This Society has £82 of its own funds, most of which is represented by outstanding loans made to members several years ago. The Secretary has experienced great difficulty in collecting any loans, but all of them are believed to be recoverable. In September 1935 the Society obtained from a private individual a loan of £62. 10. 0 which was distributed amongst those members who were not already indebted to the Society.

Georgetown. The Georgetown Society has been unable to obtain a loan for some years, but £21 of the Society's own funds lent to members in December, 1934 were collected in December, 1935. A bad debt of £10. 1. 10 was written off. Other Assets of the Society amount to about £6.

Troumaca. The Liabilities of this Society amount to about £42 of which £24 is still owing to the Troumaca Temperance Society. Outstanding loans amount to nearly £41. Only £1 was collected during the year and this has been spent in paying the Auditor's fees for the last two years. Very little interest is shown in the Society by its officers. Agriculturally, the Troumaca district is a poor one, and some members would find great difficulty in repaying their loans.

Redemption. No loan has been granted to this Society for a number of years. The Society has about £12 of its own funds, £10. 12. 0 of which is represented by outstanding loans. The loans are believed to be recoverable but except for the collection of about twelve shillings, there was no other transaction during the year.

Three Rivers. A loan of £300 lent to the Society by Government in June 1934 was repaid by the Society in June 1935. A few members defaulted in their payments but all loans were repaid to the Society before the end of the year.

The Arrowroot and Syrup Works on the Three Rivers Estate were repaired and leased to the Society by Government at the beginning of the year for a pepper-corn rental of one shilling per annum. Regulations for the control of the Works were established by legislation in February 1935. The profits accruing from the operation of the Works during the year amounted to £31 16 8½ some of which was used for carrying out further improvements to the buildings and equipment.

Several irregularities occurred in the procedure at the Annual General Meeting of the Society in July 1935, and it was found necessary to cancel the registration of the Society, to make modifications in the schedules to the Agricultural Credit Societies Ordinance, and to reform the Society. The Committee of Control refused to recommend the granting of another loan until this had been done. No loan was, however, obtained during the year as by the time the changes had been made members had already started to reap their crops.

APPENDIX V.

REPORT ON THE WORKING OF THE GOVERNMENT COTTON GINNERY FOR THE PERIOD 1ST JANUARY TO 31ST DECEMBER, 1935.

Ginning and Baling.

The total quantity of Sea Island seed cotton received for ginning was 324,155 lb. which consisted of 295,613 lb. white and 28,542 lb. stained. The lint obtained was 74,439 lb. white and 6,837 lb. stained giving a total of 81,276 lb.

The amount of seed cotton ginned during the previous season was 159,166 lb. white and 26,868 lb. stained, a total of 186,034 lb. The lint obtained during the 1933-34 crop was 45,546 lb. white, and 6,356 lb. stained making a total of 51,902 lb.

Oil Expressing and Refining.

Oil was expressed from 514,890 lb. of cotton seed which included 166,710 lb. from the Kingstown Cotton Factory, 37,507 from another Ginnery and 115,888 lb. of Marie Galante seed obtained from the Union Island Ginnery in the St. Vincent Southern Grenadines.

The quantity of seed from which oil was expressed during the previous season was 384,776 lb.

The quantity of oil expressed for the season was 3,073 gallons all of which was sold locally.

The residue of the oil refining kettle was used for soap making; 1,777 bars of soap were manufactured.

Purchase of Cotton On Co-operative System.

The advances made on Sea Island Cotton for the 1934-35 crop were 4 cents per lb. on white and 1 cent per lb. on stained. The purchases amounted to 160,355 lb. white and 33,036 lb. stained, making a total of 193,391 lb.

The figures for crop 1933-34 were 118,629 lb. white and 18,686 lb. stained, a total of 137,315 lb.

The lint obtained was 40,803 lb. white and 7,727 lb. stained, a total of 48,530 lb.

A bonus equal to 93% of the money advanced was paid on the cotton purchased during the year 1933-34 and one equal to 58% was paid on cotton purchased during the year 1934-35.

Other Operations.

23,508 lb. cob corn were shelled and 5,501 lb. corn ground into meal.

Grain &c., fumigated and stored in the moth-proof rooms totalled 19,268 lb.

26,147 lb. cotton seed were selected and disinfected for planting. 43,014 lb. stained cotton-seed were disintergrated for use as manure.

The summary of operations and transactions for the last two years is as follows :—

	1933-34.	1934-35.
Seed cotton received and ginned ...	186,034 lb.	324,155 lb.
Cotton seed expressed ...	384,776 ,,	514,890 ,,
Cotton seed disintegrated ...	30,814 ,,	43,014 ,,
Seed cotton purchased ...	137,315 ,,	193,391 ,,
Corn shelled ...	20,280 ,,	23,508 ,,
Corn ground into meal or stockfeed ...	12,966 ,,	5,501 ,,
Cotton seed selected and disinfected for planting ...	8,212 ,,	26,147 ,,
Grain etc., fumigated and stored ...	3,852 ,,	19,268 ,,
Cotton seed oil expressed ...	2,602 gals.	3,073 gals.
Soap manufactured ...	1,428 bars.	1,777 bars.
Cotton seed meal delivered ...	133 tons.	176 tons.

APPENDIX VI.

THE WORK OF THE COTTON EXPERIMENT STATION FOR THE SEASON 1935-36.

FOREWORD.

Only the progress of those experiments directly connected with the cotton ndustry in St. Vincent is dealt with.

Standard V. 135.

The staple length of V. 135 now being a fixed character, attempts are being made to increase the yield of this strain by straight selection of strains with higher weights of lint per seed and with a greater number of bolls per tree.

It is contended that although V. 135 has been self-fertilized for many generations, it is possible, within limits, to increase its lint index without detriment to the length and quality of its staple. A mean increase of 5·7% was obtained in the lint index of a selected V. 135 strain this season, and fifteen selections with even higher values for this character are being carried forward next season. It is of interest to record that the ginning out-turn of eleven of these selections is over 26%.

This season's work has also demonstrated that a relationship exists between number of seeds per boll, number of bolls per tree and node number, and observations will be made next season to determine the extent to which yield is affected by these characters.

As in the past few years, Diamond Estate was planted with selfed seed from the Station's multiplication area. Approximately 33,000 lb. of seed were obtained from this selfed material for planting purposes, but as next season's commercial acreage is expected to exceed 5,000 acres a reserve supply of about 8,000 lb. of seed were obtained, after careful field examination, from Union Estate.

The multiplication area of ·74 acres at the Station yielded 1,480 lb. of seed cotton of which 42·9% was self-fertilized. A yield of 474 lb. of clean selfed seed was obtained, which should be sufficient to plant sixty acres at Diamond Estate this year

The Station's multiplication area is to be increased next season to two acres and fifteen pure line V. 135 plants, averaging over 200 bolls per tree, have been selected for planting these plots.

The Red Sea Island Strains.

It will be remembered from previous reports that the characters red plant body-weak corolla spot were transferred from Trinidad Red Kidney to V. 135, so that in the event of the Red V. 135 strain being grown commercially off-type plants (green bodied or full spotted), could be easily detected and eliminated.

The forty-two strains grown this season were all pure for red body, weak spot and superfine length, and maintained their superiority to V. 135 in weight of boll contents and ginning out-turn. V. 135 is still, however, superior in number of bolls per tree and number of seeds per boll.

A lint measurement of 70 mm. was obtained from one of the selections which indicates that Red Sea Island may possibly now be as good as V. 135 in spinning value. These strains now appear to be so promising that yield and lint comparisons with V. 135 will be made next season.

The V. 135—Montserrat Sea Island Strains.

The growth of these strains was disappointing. The dry conditions at the end of the season caused much irregularity in staple lengths and the bearing was, in general, poorer than it was last season. Notwithstanding, some very good selections are being carried forward next season including some with intermediate length staples (53–55 mm.) and short staples (50–52 mm.). This step has been considered necessary owing to the possibility of V. 135 being replaced by shorter stapled and heavier yielding strains.

Many of these strains are now pure for superfine length and combine with it heavier weights of lint per boll, lint per seed and higher ginning out-turns.